OCCASIONAL PAPERS IN ARCHAEOLOGY 90

Anders Kaliff & Terje Oestigaard

Early Indo-European Silk Roads

Ecologies of Cattle, Waterways and Winter Migrations

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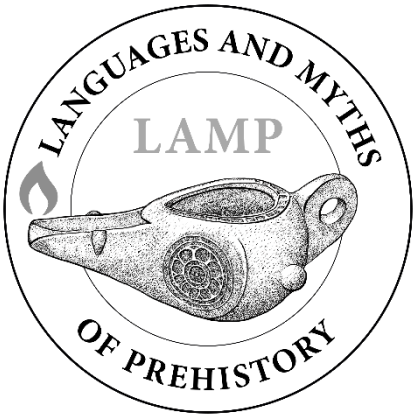

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An ecological perspective that considers winter conditions and waterways, viewed from the perspective of cattle, may offer new insights into potential migration routes across the Eurasian steppes. Today, nearly half the world's population speaks an Indo-European language. The spread of these languages through prehistoric migration has been a subject of debate for over 200 years. Recent advances in ancient DNA studies have reignited this discussion and sparked academic disputes. This analysis highlights a fundamental but often overlooked aspect of early pastoral migration in an ecological context: the role of cattle. By focusing on cattle, certain migration routes emerge as more viable, while others appear unfeasible in light of specific ecological conditions and natural obstacles. The Eurasian steppe, characterised by long, harsh winters and bisected by major north-south-flowing rivers, presents significant ecological barriers to east-west migrations to Europe and the Ural Mountains. Yet, the earliest major migrations occurred in east-west direction. Even in winter, river valleys and riverbeds, with their generally reliable supply of water and vegetation, would have been of fundamental importance for the survival of large herds. Moreover, when rivers were frozen in winter, pastoralists could easily cross north-south-flowing rivers and use the east-west waterways as highways for rapid movement over vast distances. In this light, we argue that, during the winter, the great rivers of Eurasia were key enablers of early Indo-European migration and expansion.

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Anders Kaliff & Terje Oestigaard
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1. Introduction

The hypothesis that East and West are connected was posited almost 250 years ago. The origins and the Indo-European peoples and their migration routes have evolved into a state-of-the-art field of interdisciplinary research. It is one of the areas with the greatest potential for new knowledge production, where old paradigms, dogmas and interpretations have been tested and, by and large, confirmed. Studies of ancient DNA since 2015 have proposed different migration routes, not only from the steppes to Europe, but also from Europe to the Ural Mountains and further into Asia. The origins of Indo-European culture lies in the steppes north of the Black Sea in Ukraine, from where it spread to Western Europe and then gradually moved eastward to Russia, Iran and India.

Ancient DNA (aDNA) is an invaluable source for understanding migration routes, as the physical presence of a person with a specific DNA provides concrete evidence that they lived in a particular place at a certain time. The DNA profile of the populations that migrated from the steppes is clearly different to that of the original European farmers. A common criticism of aDNA research and Indo-European studies is that language is not in the genes. While this is, obviously, correct, it is also a simplistic and intellectually lazy argument. In most cases, children speak the same language as their parents, as communication, culture and cosmology would otherwise be incomprehensible – no family or society could function without a shared language. As we will show, the linguistic analysis of the spread of languages aligns remarkably well with the archaeological evidence and the large-scale aDNA studies, even if painted with a broad brush.

However, despite the abundance of evidence, models of migratory routes remain challenging. By nature, abstract models on maps only provide a general sketch of cultural-historical migrations. The arrows on maps often cross lakes or mountains and do not represent literal migration routes that real people, with or without cattle could travel along. Instead, they are broad indicators of direction in time and space. This is not a criticism of the different models themselves, but an acknowledgement of the inherent limitations in any model that attempts to present prehistoric large-scale migration routes on a map (Fig. 1).

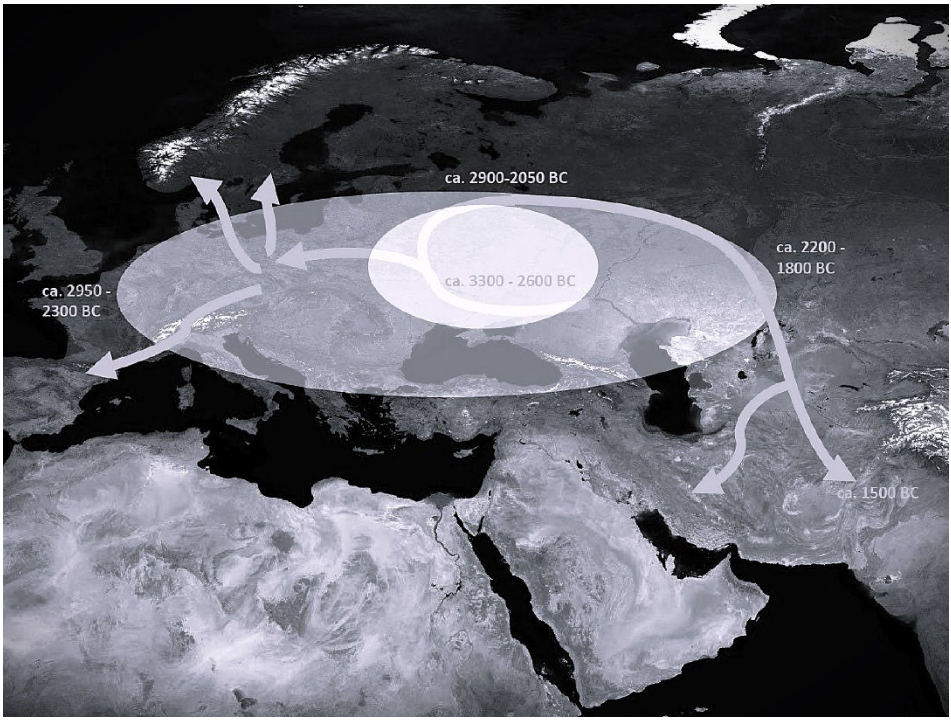

Fig. 1. Model and schematic map of early Indo-European cultures and migrations. (Background map by Visible Earth, NASA, illustration by the authors).

In this analysis, building on previous linguistic, archaeological and aDNA studies, we approach early Indo-European migration routes from a different perspective: through a cultural study of cattle and ecology. To paraphrase an old saying: don't just follow the money, follow the cattle. Focusing on Indo-European ecologies offers a productive framework to study prehistoric migrations and cultural-historical processes (Larsson, Olander & Jørgensen (eds.). 2025). This approach is especially fitting as the word 'ecology' is derived from the Greek *oikos* [οἶκος], meaning 'home', 'household' or 'place to live' (Fig. 2).

Originally, the Indo-Europeans were primarily specialized pastoralists. Although historically pastoralists may also have practised various forms of agriculture and made a broad range of adaptations, cattle remained their main economic and ecological base. By focusing on the lives and needs of cattle, one can address potential Indo-European migration routes from a new angle.

Fig. 2. Pastoralists' main concern is the welfare of their cattle. In changing ecologies, particularly in regions with cold winters, the survival of humans and animals has always been a great challenge. Photo: Terje Oestigaard.

There is one natural factor that severely limits potential migration paths: cows. Pastoral societies are defined by their cattle, and to better understand the route of prehistoric migrations and movement of people one must therefore follow in their footsteps.

The ecological zone north of the Black Sea is a steppe landscape with harsh winters and marked seasonal changes. Cattle need to be watered and fed on a daily basis and this need determines their movement patterns. During muddy springs and snowy winters, the physical environment restricted the movement of cattle. These days, livestock usually spends the winter indoors, but this is a relatively recent development. In prehistoric times, cattle were outdoors all year round. While the cold formed a major challenge, winters may also have offered opportunities, enabling travel across frozen bogs, swamps, lakes and rivers. Although Indo-European studies usually focus on east-west migration, the geography of Eastern Europe and Central Asia is characterized by numerous rivers flowing mainly in a north-south direction, effectively bisecting the landscape. This made summer migration virtually impossible, as cows have limited swimming ability and would have been at serious risk of drowning.

Our approach is based on real people doing real things. Some migrations and migration routes were not viable due ecological and technological limitations, as well as the needs of livestock. Quite simply, cows are cows. Methodologically, we draw on Jack Goody's foreword to Fredrik Barth's *Cosmologies in the making* where he writes: 'the basic procedures of such analysis involve first making a series of functional or logical models which can be interwoven, then, second, constructing a single model which can generate the different forms' (Goody 1987: vii-viii). Cattle and ecology offer an excellent point of departure for developing such functional models, enabling a bigger picture of human movement. Importantly, as Gunnar Haaland points out, one should not confuse the conceptual map (the model) with reality (the modelled). A model will never fully represent reality; rather, it 'serves as a means for modelling some aspects of social "reality", but the model constructed is of course not identical to all the characteristics of the reality modelled' (Haaland 1991: 14).

Our main objective in this analysis is to address an apparent paradox in the understanding of the initial Indo-European migration. Classical aDNA studies (Allentoft et al. 2015; Haak et al. 2005) and several subsequent ones have established that the Core Indo-European migration originated in the Yamnaya culture on the Pontic Steppe, with

an early expansion towards the Altai region in the East (before 3000 BC) and equally rapid westward expansion towards Central and Northern Europe around 2950 BC. Recent studies have established that Yamnaya culture originated around 3300 BC on the steppes north of the Black and Caspian Seas (Lazaridis et al. 2025; Nikitin et al. 2025), reaching its greatest extent – from Hungary in the west to Kazakhstan in the east – around 3000 BC. Thus, there were very early west-east and east-west migrations, as well as subsequent, long-distance migration, mainly along a latitudinal axis. However, in all historic and ethnographic documentation, the migration of pastoral groups across the Eurasian steppes is primarily north-south along the main rivers. Pastoral groups migrated with their herds, moving northward in summer and southward in winter. In this analysis, we present an ecological model that explains and combines the west-east / east-west migrations with the north-south / south-north migrations.

We focus on two questions: First, from an ecological point of view, where did the best cattle migration routes run, and second, to what extent did winter and waterways form a hindrance or an opportunity for migration?

2. A short history of Indo-European research and migration

From language to genetic studies

The British colonial official and orientalist William Jones (1746-94) was one of the first to point out the similarities between the ancient Indian languages, i.e. Sanskrit, and European languages. This is seen as the beginning of Indo-European studies (Fig. 3). Jones, a renowned linguist, was appointed as a judge at the High Court of Bengal in British India in 1783. In addition to his service, he continued his research. He soon became an expert in Sanskrit and founded the Asiatic Society of Bengal in 1784. One of the lectures he gave there in 1786 – which was published two years later (1788[1814]) – is widely considered as the starting point of Indo-European language research.

> The Sanscrit language, whatever be its antiquity, is of a wonderful structure; more perfect than the Greek, more copious than the Latin, and more exquisitely refined than either, yet bearing to both of them a stronger affinity, both in the roots of verbs and the forms of grammar, than could possibly have been produced by accident; so strong indeed, that no philologer could examine them all three, without believing them to have sprung from some common source, which, perhaps, no longer exists; there is a similar reason, though not quite so forcible, for supposing that both the Gothic and the Celtic, though blended with a very different idiom, had the same origin with the Sanscrit; and the old Persian might be added to the same family (Jones 1788[1814]): 28-29).

Jones's lasting legacy rests on his proposal of a connection between all Indo-European languages, with the ancient Indian language as a clear and early representative. He argued that Sanskrit, Greek and Latin shared a common root, and that they were also related to languages such as Gothic, Celtic and Persian. Although Jones was not the first to present this idea nor entirely correct in all assumptions, his name is more closely associated than any other with the emergence of comparative Indo-European research.

Fig. 3. Sir William Jones (1746-1794). Illustration by James Posselwhite (1798-1884). Source: National Library of Wales. Public domain.

Developed as a linguistic discipline, comparative Indo-European research spread over the course of the 19th century into fields such as the history of religion and the emerging discipline of archaeology. A central question in the latter was whether speakers of an early Proto-Indo-European language – the ancestor of all Indo-European languages – had spread across Europe and parts of Asia as a result of migration.

A tragic consequence of the connection between migration and the spread of culture was the inevitable link to racial biology that emerged during the late 19th and early 20th centuries. Early Indo-European peoples in the Indo-Iranian area described themselves as *Arya*, Aryans, a term that became synonymous with Indo-Europeans during the same period. Although the original term was not associated with racial biology or racism, it has nevertheless retained a negative connotation. However, the term was widely used in archaeology – at least within the English-speaking part of the discipline – by the archaeologist Gordon Childe (Fig. 4), who was anything but racially influenced (see Childe 1933). In *The Aryans. A Study of Indo-European Origins* (Childe 1926), Childe explains that the term is more concise and more appropriate than the awkward term 'Indo-European':

> Philologists will at once complain that the term 'Aryan' is unscientific. Of course, I know that only the Indians and Iranians actually designated themselves by this name. But what expression is to be used conventionally to denote the linguistic ancestors of the Celts, Teutons, Romans, Hellenes, and Hindus if Aryan is to be restricted to the Indo-Iranians? ...The word Indo-European is clumsy and cannot even claim to be scientific now that Indian Sanskrit is no longer the most easterly member of the linguistic family known... Aryan on the other hand has the advantage of brevity and familiarity. I therefore propose to retain it, quite conventionally, in the traditional sense (Childe 1926: xi).

Unfortunately, in this case, Gordon Childe was wrong, as the concept of Aryans became indelibly associated with Third Reich Germany and its theories of racial purity. This had far-reaching consequences for comparative Indo-European research: Aryans and Indo-Europeans were identified with the origin of the 'pure' Germans and thus came to cast shadows over all research on the Indo-Europeans for a very long time after the end of the Second World War, which to a certain extent still lingers today. In particular, the interpretation of the spread of Indo-European languages and cultures through migration came to be considered obsolete – a non-issue – with a few notable exceptions (Figs. 5 & 6), such as the studies of Marija Gimbutas and others (e.g. Gimbutas 1956, 1970, 1974, 1989, 1991; see also Haaland & Haaland 1982, 1995).

Fig. 4. Vere Gordon Childe (1892-1957). Source: The National Library of Australia. Public domain.

Fig. 5. The Kurgan hypothesis and Indo-European migrations. Source: Wikipedia, Dbackmann (CC BY-SA).

Fig. 6. Marija Gimbutas (1921-1994). Photo: Monica Boirar, 1993.

As a consequence, other explanatory models gained precedence, with far-reaching consequences for research up to the 2010s. The rapid development of ancient DNA research triggered a radical paradigm shift. In particular, two ground-breaking aDNA studies published in *Nature* in 2015 (Allentoft et al. 2015; Haak et al. 2015) showed that humans started spreading from the steppes north of the Black and Caspian Seas towards Europe around 3000 BC and, shortly thereafter, towards the Indo-Iranian area. These studies spurred further research on Indo-European migration, with a number describing plausible scenarios for the spread of Indo-European languages and cultures.

Once again, migration is seen as a driving force behind cultural and language change. However, even in recent years, some have expressed doubts as to whether human migration historically contributed to the spread of language and culture. Often, however, such doubts rest on an incomplete understanding of the role of genetics.

Contrary to what critics often claim, DNA research does not present a simplified or one-dimensional account of ancient migrations, which is why the ongoing debate about DNA and archaeology is both necessary and welcome (e.g. Kristiansen et al. 2017; Heyd 2017). Of course, one cannot claim that people who speak a certain language necessarily share other cultural characteristics, such as religion, mythology and social structure. Languages can spread independently of cultural affiliation and genetic heritage. Today's global spread of English is a clear example, although it is hardly representative from a historical perspective. At the same time, it would be naive to deny that physical kinship, language, cultural heritage and religious community have historically been significant factors for identity and cohesion between people.

Language and ethnicity are certainly very closely linked, not least because it is through language that most of human knowledge is transmitted, including knowledge of history, culture, lineage and family. Therefore, language and social dynamics have often interacted and language has been transmitted from generation to generation, intimately connected with how one becomes part of the family, group and society into which one is born. Modern DNA technology has thus opened entirely new avenues for studying human kinship. Interestingly, some of the findings support older archaeological theories long considered outdated, particularly those suggesting the arrival of new groups from the steppes in the late 4th millennium BC that spread Indo-European language and culture.

The core and origins of the Indo-Europeans

From around 3300 BC for more than a millennium, Yamnaya culture (c. 3300 – 2500 BC) and its descendants spread Indo-European languages and culture from the Pontic steppe north of the Black and Caspian Seas across Europe, Central and South Asia, Siberia and the Caucasus. In its developed form, Yamnaya culture appears around 3300 BC, with its geographical influence expanding until it covered an area from Hungary in the west to Kazakhstan in the east by 3000 BC. The Core Indo-European language, which forms the basis of all Indo-European languages that exist today, first emerged in Yamnaya culture.

Extensive east-west migration and important cultural encounters had taken place in the Pontic steppe area even before the development of Yamnaya culture, laying the foundation for the later spread of Core Indo-European language and culture. One such prehistoric encounter brought together farmers from Neolithic Europe – what Gimbutas called 'Old Europe' – and foragers and pastoralists from the Eurasian steppe. A westward migration from the Caucasus-Lower Volga area took place in the era before the formation of the Yamnaya culture, with some groups merging with farmers from the Cucuteni-Trypillia culture and giving rise to the so-called Usatove culture around 4500 BC. Groups belonging to the Cucuteni-Trypillia had already spread eastwards across the Carpathians to the Dnieper Valley around 4800 BC. Another part blended with foragers instead of farmers, and thereby formed the so-called Serednii Stih culture. When these in turn mixed with migrants from the Caucasus-Lower Volga, the Yamnaya culture was formed. They expanded from 3300 BC, after which they embodied the rich tapestry of genetic ancestry of the preceding populations (Nikitin et al. 2025).

Thus, the Yamnaya culture was itself the result of earlier migrations, constituting a population predominantly formed by men from the steppe and women from the Caucasus-Lower Volga region. Recent findings suggest that the language which developed into Proto-Indo-European was originally predominantly spoken by women. This implies that its roots lay in the language spoken by older (pre-Indo-European) groups of the Caucasus-Lower Volga region. At first glance, it may seem paradoxical that the dominant language in the strongly patriarchal Yamnaya culture was transmitted via women.

However, this can be explained by demographic and reproductive dynamics. Genetic evidence shows a narrow male bottleneck with an elite of men likely fathering the vast majority of children. Estimates

suggest that men were greatly outnumbered by women and that each Yamnaya man may have had children with between four and ten women. In such a context, men would have divided their time between different households and were probably less involved in raising their children.

As a result, mothers primarily transmitted their Proto-Indo-European language to the next generation, while the fathers' language played a secondary role in the formation of Core Indo-European. This would also explain the connections between the extinct Anatolian language group and the descendants of Core Indo-European languages. In both cases, the influence of women from the Caucasus-Lower Volga was crucial (Lazaridis et al. 2025).

Particularly the presence of a common agricultural vocabulary in Core Indo-European suggests that the linguistic homeland of the Core Indo-European language community should be sought in the western part of the Yamnaya culture. 'Lexically, the transition from basal to Core Indo-European resembles a language community penetrating a fundamental cultural barrier separating the pastoral and agricultural realms. Such a barrier has been identified archaeologically in the steppe as the Dnieper river…' (Kroonen et al. 2022: 34).

This suggests that the most probable area for the fusion between steppe pastoralists and early European farmers lies on the lower reaches of the Dnieper River and the area to the west, directly north of the Black Sea. A likely scenario is that agricultural knowledge, and the vocabulary that came with it, first spread north along the Dnieper River via seasonal migrations (Fig. 7). Gus Kroonen et al. (2022) continue:

> In conclusion… the linguistic homeland of the core Indo-European language community cannot be located in the eastern steppe, but must be situated around, and extending to the west of, the Dnieper River. After the formation of the core Indo-European dialect continuum in this area after ca. 3300 BCE, it gradually developed into a network of increasingly evolved and disconnected varieties of Indo-European speech, thus foreshadowing the final fragmentation of the language and the movements of the various branches into Europe and Asia… Quite possibly, segments of the core Indo-European speech community moved west before they moved east, including those groups that ultimately introduced Tocharian and Indo-Iranian to Asia. For the steppe component in Indo-Iranians, the Eastern European Corded Ware has been sugges-

ted as the mediator of Yamnaya ancestry. For Tocharian, it may be necessary to assume an indirect dispersal as well in view of the late spread of agriculture to the eastern steppe (Kroonen et al. 2022: 34-35).

Fig. 7. Map of Dnieper River Basin. Source: Wikimedia commons. Dnieper Basin River Town German, Україна. The rivers Dnieper (A) and Pripyat (B) are pointed out and modified from the original map.

The early interaction between steppe people and European farmers in south-eastern Europe was evidently of great importance for subsequent developments. Core Indo-Europeans, in addition to their steppe heritage, also carried genetic, cultural and linguistic elements inherited from Neolithic Europe. The first expansion westwards in the northern forest-steppe region gave rise to the Corded Ware culture, characterized by the usage of corded pottery, as well as the widespread use of polished battle axes – both prominent features of this culture. The westward expansion of the Corded Ware culture from 2950 BC onwards marked the first major Core Indo-European influx into Northern Europe, bringing the male Y-haplogroup R1a-Z283 subclade as far west as present-day Germany and the Netherlands and the R1a-Z284 subclade into Scandinavia.

While the different Y-chromosome R1a-subclades are mainly associated with the Corded Ware expansion, the R1b is generally related to an earlier, more southerly wave of migration from the steppes westward. Although proceeding at a much slower pace, this migration nonetheless had a significant long-term impact. Originating on the northern shores of the Black Sea, these groups moved westwards towards the Balkans, eventually reaching the Hungarian Plain around 2800 BC, by which time the northern Corded Ware expansion had already reached Scandinavia. Around 2500 BC, these groups expanded further north after merging with the indigenous Neolithic populations of the Danube Basin. Even at this stage, they still remained almost exclusively R1b on the paternal side, despite incorporating a high proportion of non-Indo-European lineages on the maternal side over time. When these groups encountered local Corded Ware and Bell Beaker societies – 'cousins' and also the descendants of the Core Indo-European Yamnaya of the steppe – abrupt changes occurred, leading to the emergence of the Únětice culture (c. 2300-1600 BC), the first Central European Bronze Age culture, which originated in Bohemia and eastern Germany.

This southern migration took place in several stages over a considerably longer period. The areas where they first arrived – the Carpathian region and the Balkans – were populated by some of the most advanced agricultural societies of the time, especially the large settlements of the Cucuteni-Trypillia culture. The region was also rich in metals, such as tin, copper and gold, which were very attractive to this early metallurgic culture. The early period of the Bell Beaker culture (from about 2900 BC) in Western Europe was by all accounts not Indo-European, but a continuation of earlier, local megalithic cultures, with-

out any steppe admixture (e.g. Martiniano et al. 2017). However, by mixing with populations from the steppe, this cultural group clearly introduced Indo-European DNA into Western Europe. Recent research also suggests that the fusion of early Bell Beaker with steppe-related groups gave rise to the Italo-Celtic branch of the Indo-European language tree (Yediay et al. 2025).

Originating in its oldest phase along the Atlantic coast of present-day Portugal, the Bell-Beaker phenomenon spread northwards to the British Isles and France and eastwards towards Germany. DNA studies confirm the presence of around 50% R1b-L51 mixed with Bell-Beaker ancestry. In some areas, particularly the British Isles, this process appears to have caused a dramatic demographic impact (e.g. Olalde et al. 2018). As the Únětice culture began to develop around 2300 BC, individuals from this culture show a slightly higher percentage (60-65%) of Yamnaya ancestry. This ancestry now includes mtDNA lineages, suggesting that by this stage, men and women with steppe ancestry were migrating together. This marks a contrast with the first migration wave when steppe men generally fathered offspring with local women. This suggests that west-east connections with the steppe homeland appear to have been maintained over time. Archaeological finds from the early Únětice culture further support this as they show clear connections with Yamnaya culture, contrasting with the continuity from the Bell Beaker culture.

3. A short history of pastoralism and Proto-Indo-Europeans

Previous research

Animal husbandry and a nomadic lifestyle are strongly associated with early Indo-European culture. Today's dominant theory is that the early spread of nomads across Eurasia went hand in hand with a strongly mobile pastoral economy (e.g. Anthony 2007; Kristiansen 2007; Kuzmina 2008; Kristiansen et al. 2017; Racimo et al. 2020). Although the many drivers of migrations still need to be explained (cf. Nordquist & Heyd 2020; Wilkin, Ventresca Miller & Fernandes et al. 2021), it is clear that large-scale livestock farming was a decisive factor. Domesticated grazing animals, especially cattle, formed a fundamental part of this economy. Cattle also play a key role in religious beliefs and rituals, with long historic continuities in various Indo-European cultures (Fig. 8) (e.g. Puhvel 1978: 354-362).

The ecological foundation of Indo-European societies is not a new area of research. In his pioneering work *Priests, Warriors, and Cattle: A Study in the Ecology of Religion* (1981), historian of religions Bruce Lincoln took a cue from Åke Hultkrantz' (1966) 'ecology of religion' to show how two culturally discrete yet ecologically and socio-economically analogous semi-settled pastoral cultural complexes – namely, present-day Nilotic peoples (Nuer, Dinka, and Masai, see below), and the hypothetical speakers of Proto-Indo-Iranian and Proto-Indo-Europeans – could be compared. This approach revealed striking similarities in systems of thought and ritual practice (Lincoln 1981). Building on these pioneering studies, we argue that the topic is far from exhausted. We are now better equipped to outline the socio-economic foundations of Indo-European society by asking questions about ecological affordances.

Furthermore, sacrificial rituals are considered a central element in Indo-European ritual traditions, with roots that can be traced back to the creation myth itself (e.g. Lincoln 1975: 212-145, 1986: 5-20, 41-59). The central theme of this creation story – in its various iterations – is the idea that the first living being is killed – sacrificed – then dismembered and the world is shaped out of its body parts (see also Oestigaard 2022a).

Fig. 8. In the Norse cosmology, Ymir suckles the cow Audhumla. Painting by Nicolai Abildgaard (1749-1809). Public domain.

In this context, both humans and animal bodies represent a microcosm of the cosmos, and man's sacrifices are performed as a reenactment of the original act of creation, according to the mythic pattern. The significance of this creation myth and how it is reflected in sacrifices and burial customs, is also clearly evident in the archaeological material from various regions and periods within the Indo-European diaspora, especially in Scandinavia (e.g. Kaliff 2005, 2007, 2025; Kaliff & Oestigaard 2020, 2022, 2023).

Animal sacrifices in particular were designed as a reflection and repetition of this primordial act. In certain versions of the myth, a primordial bovine also plays an important role, and there is reason to believe that the cow was an important sacrificial element in the oldest sacrificial tradition. In an Iranian version of the myth, an ox or a bull – a male bovine – is sacrificed, and all other living species come from its body parts. This theme gradually diminishes in later Zoroastrianism, where Zarathustra reinterprets the primordial sacrifice as a sin (Lincoln

1975: 135-144; West 2007: 358). In Europe, by contrast, a female bovine – a cow – appears as a provider of milk and nutrition. This shift may reflect cultural differences between divergent Indo-European branches. The cow as a provider of milk rather than meat could be in line with the fact that the secondary product revolution with regard to dairy products became increasingly important during the Indo-Europeans' spread across Europe. Recent aDNA studies (Wilkin, Ventresca Miller & Fernandes et al. 2021) show that the importance of dairy products increased significantly during this period, in parallel with an increase in lactose tolerance in humans. On the steppe, however, during the first Yamnaya expansion, the animals seem to have been used mainly for their meat.

The Corded Ware complex and the Fatyanovo culture

Ever since the ground-breaking aDNA results published in 2015 (Allentoft et al. 2015; Haak et al. 2015), the migration of nomadic pastoralists from the Eurasian steppe has been firmly established as a decisive factor behind the early spread of Indo-European language and culture. However, more recent, broader studies have revealed the great complexity of this event. New data now allow us to trace in greater detail the westward movement of people from the Pontic steppe into Europe – where they formed the Corded Ware culture in its various variants in the early 3rd millennium BC – and, importantly, the subsequent reflux back towards the steppe (Saag et al. 2021). This remigration has great significance for subsequent events.

Landscape historians describe how the rapid expansion of the Yamnaya-related people triggered dramatic changes in the landscape (Racimo et al. 2020), as these steppe dwellers adapted to new landscapes by cutting down forests and expanding pasture and grasslands. On Jutland in Denmark, huge areas were deforested soon after the arrival of humans and cattle of the Corded Ware culture, apparently recreating the steppe landscape they left behind in the east (Andersen 1993; Kristiansen 2007). Kristiansen et al. (2017: 336) point out:

> Corded Ware people burned down forests on a massive scale, thereby creating open, steppe-like grazing lands for their herds. A more gradual opening of the landscape is also found in other regions, while subsistence seems to have been a variable mix of cultivation, husbandry and some hunting and gathering.

Thus, all societies were characterised by their need to secure food for humans and fodder for animals during the harsh winter season. As a result, the lives and livelihoods of agriculture, transhumance and pastoralism became increasingly intertwined. In the cold north, climatic and ecological conditions made seasonal migration to milder areas impossible, leading all societies to become sedentary to varying degrees. In rituals and cosmology, it appears that pastoral perceptions and practices were gradually absorbed into pre-existing agricultural cosmology, creating a unique Indo-European tradition north of the Alps (e.g. Frazer 1912a, 1912b; see also Kaliff & Oestigaard 2022; Oestigaard 2021, 2022b). Although studies of the Corded Ware complex have tended to focus on western regions, it actually extends far to the east, to the Middle Volga and Lower Kama River basins. Most of this more than 1,400 × 800 km area was occupied by the so-called Fatyanovo culture and its eastern variant, the Balanovo cultures (c. 2800-2050 BC), both representatives of the overall Corded Ware culture, with similar features but regional differences. With its immediate roots in the areas today constituting the southern Baltic States, Belarus and northern Ukraine, it spread east along the different river valleys, eventually becoming a key component in the further development of much of Bronze Age Eurasia:

> As Fatyanovo groups spread eastward down the Volga they discovered the copper ores of the western Ural foothills, and in this region, around the lower Kama River, they created long-term settlements. The Volga-Kama region, which became the metallurgical heartland for almost all Fatyanovo metallurgy, has been separated from the rest of Fatyanovo and designated the Balanovo culture. Balanovo seems to be the settled, metal-working aspect of eastern Fatyanovo. At the southern fringe of Balanovo territory, in the forest-steppe zone of the middle Volga and upper Don where the rivers again flowed south, a fourth group emerged (after Middle Dnieper, Fatyanovo and Balanovo). This was the Abashevo, the easternmost of the Russian forest-zone cultures that were descended from Corded Ware ceramic traditions. The Abashevo culture played an important role in the origin of Sintashta (Anthony 2007: 382).

Through the circumferential movement – the migration from Yamnaya to the west and the return of steppe-related people via the Fatyanovo-Balanovo culture – a merged heritage is brought back to the steppe in the east (Fig. 9).

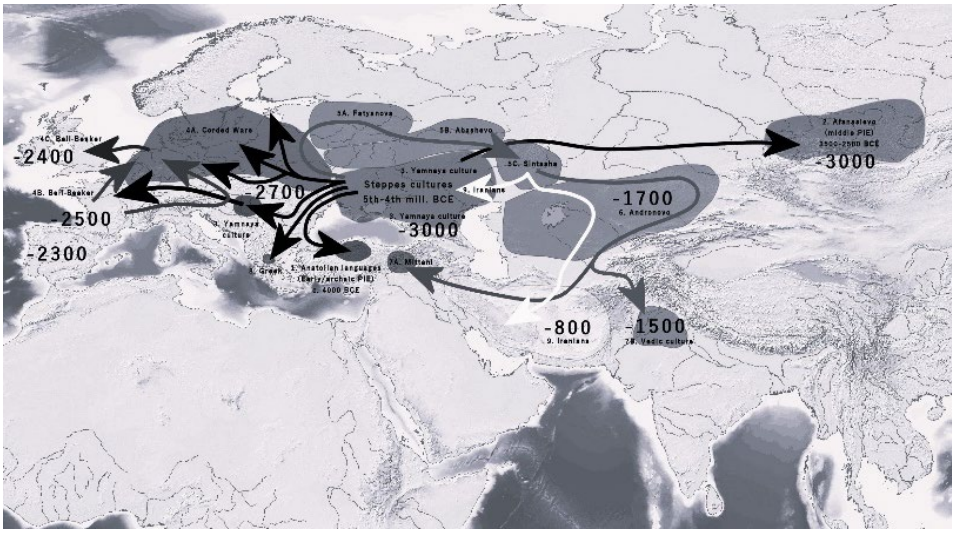

Fig. 9. Early Indo-European cultures. Source: Wikimedia commons. Map created from DEMIS Mapserver (public domain) and drawing by पाटलिपुत्र. CC BY-SA 3.0

These eastern variants of the Corded Ware culture, as well as the later Abashevo culture (2500-1900 BC) – which constitutes the eastern-most offspring of the Corded Ware complex – play a crucial role in this process:

> The Fatyanovo Culture, together with its eastern twin, the Balanovo Culture, forms part of the pan-European Corded Ware Complex… Its immediate roots are to be found in the southern Baltic States, Belarus, and northern Ukraine (the Baltic and Middle-Dnepr Corded Ware Cultures), from where moving people spread the culture further east along the river valleys of the forested flatlands. By doing so, they introduced animal husbandry to these regions… Fatyanovo Culture is formed by the reverse movement to the (north-)east of the Corded Ware Complex… Through its descendants (including Abashevo, Sintashta, and Andronovo Cultures) it becomes a key component in the development of the wider cultural landscape of Bronze Age Eurasia (Nordqvist & Heyd 2020: 65).

The Fatyanovo culture developed through close interaction with the older, Neolithic European farming cultures in the south-west, from which both innovations and genes were incorporated (Saag et al. 2021)

via an encounter with the Neolithic farmers of the late Cucuteni-Trypillia culture. In this process, another cultural group with close ties to the Corded Ware complex, sometimes considered a variant of Corded Ware in its own right, plays a crucial role: the Middle Dnieper culture (c. 2800-1900 BC), located in present-day northern Ukraine and Belarus. The territory of the Middle Dnieper culture lies along a classic east-west route, which was probably also used by steppe nomads in prehistoric times. The corridor along the west-east-flowing Pripyat tributary of the Dnieper River constituted an ideal communication and transport route, a cultural bridge that conveyed the mix of Neolithic Europe and Yamnaya influences into the emerging Fatyanovo culture. Over time, Fatyanovo population gradually became genetically similar to other Corded Ware cultures, carrying a mixture of steppe and early European farmer ancestry.

The people of the Middle Dnieper culture were the first to introduce stockbreeding economies into the Russian forest zone (Anthony 2007: 377). In this way, the culture and area functioned as a 'cultural bridge' – via the Fatyanovo-Balanovo and Abashevo cultures – to the subsequent Sintashta culture (c. 2200-1800 BC) and into the emerging Indo-Iranian cultural sphere. These cultures constitute a potential east-west link between the Balto-Slavic and Indo-Iranian territories, offering a key to understanding the presence of similar cultural phenomena across geographically distant regions.

The Sintashta culture emerged in the steppes south of the Ural Mountains as a merger of the Abashevo culture – itself developed from the eastern part of the Fatyanovo culture – and the Poltavka culture (2700-2100 BC), 'cousins' of the Corded Ware cultures within the Yamnaya complex that remained in the Pontic steppes and the Lower Volga region.

According to current genetic and archaeological analyses, the Proto-Indo-Iranians trace their direct origins in the Sintashta culture (Fig. 10). The ongoing Indo-Europeanization of the Indian subcontinent, which began with the Sintashta culture c. 2200 BC, involved a blend of cultural elements as well as genetics from both steppe nomads and early European farmers, though the exact proportion remains uncertain. Thus, the Vedic people of India, like the ancient Iranians, also carried genetic heritage from Neolithic Europe, and possibly also cultural features. These legacies are still detectable in present-day populations across these areas (Sharma et al. 2009; Debortoli et al. 2020; Narasimhan et al. 2019; cf. Singh et al. 2018, Kaliff & Oestigaard 2023).

Fig. 10. Arkaim – a Bronze Age site belonging to the Sintashta culture. Source: Wikimedia commons. Rafikova. Creative commons license: CC BY-SA 4.0

The Middle Dnieper culture and the western part of the Fatyanovo culture thus provide a plausible origin for the Balto-Slavic branch of the Core Indo-European languages and culture. Y-DNA haplogroup variants of R1a, particularly M458 and Z280, may be indicators of this connection, given widespread presence today in populations across Poland, Belarus, Ukraine and western Russia. The Middle Dnieper culture – to a large extent the area around Pripyat – probably marks the early crystallization point of Proto-Balto-Slavic language and culture. The interaction with Neolithic farming cultures – mainly the late Cucuteni-Trypillia culture (5200-2600 BC) – also introduced variants of the haplogroups G2a and I2a1b, originally from European hunter-gatherers, as well as J2a and T1a, typically associated with Neolithic farmers. Through the Middle Dnieper culture, these genetic legacies spread into the emerging Balto-Slavic sphere and remain evident in the region's modern populations.

Migrations and refluxes

The Fatyanovo culture and its vast expansion back to the east, forms a link between the mix of Core Indo-Europeans and Neolithic farmers of eastern Europe, and the later-emerging Indo-Iranian culture, possibly explaining the particular link between these and the Balto-Slavic branch. This reflux movement, in which both aDNA and cultural features travelled from west to east and back again, may help explain the close similarities between geographically distant areas. In particular, the west-east reflux via the Fatyanovo culture, which resulted in the development of the Sintashta and Andronovo cultures in the east, has had a significant impact on the development of the Indo-Iranian world. A pioneering study by Saag et al. (2021), which analysed 26 individuals from the Fatyanovo culture, found that all 15 men belonged to haplogroup R1a. Notably six of them carried the R1a-Z93 variant, which characterizes the Indo-Iranian branch of the Indo-Europeans. According to current genetic and archaeological analyses, the Proto-Indo-Iranians originated directly from the Sintashta culture, south of the Ural Mountains. The Sintashta culture itself emerged from a fusion of the Abashevo culture (2500-1900 BC) – representing the easternmost extent of the Corded Ware complex – and the Poltavka culture (2700-2100 BC), a 'cousin' that had remained in the Pontic steppes and the Lower Volga region.

The Sintashta culture is clearly associated with the Y-haplogroup variant R1a-Z93, which also occurs at high frequency within the Fatyanovo culture. The southward expansion into the Iranian area and the Indian peninsula originates from the Sintashta culture. Through extensive metallurgy and, significantly, the invention of horse-drawn war chariots, this expansion was rapid and probably driven by conquest. These Indo-Iranian migrations resulted in high frequencies of R1a, also observed across South Central Asia, Iran, Pakistan and northern India. In India and Pakistan, the incidence of R1a ranges from approximately 15% to 50% of the population, depending on the region, ethnic group and caste. The percentage is generally higher in the north-western part of the subcontinent, with significantly lower concentrations in the south. Of interest is the great variation between castes: over 70% of Brahmins – the highest caste in Hindu society – belong to the R1a1 group, due to a founder effect (Sharma et al. 2009).

> A peculiar observation of the highest frequency (up to 72.22%) of Y-haplogroup R1a1* in Brahmins hinted at its presence as a founder lineage for this caste group. Further, observation of R1a1* in different tribal population groups, existence of Y-haplogroup R1a* in ancestors and extended phylogenetic analyzes of the pooled dataset of 530 Indians, 224 Pakistanis and 276 Central Asians and Eurasians bearing the R1a1* haplogroup supported the autochthonous origin of R1a1 lineage in India and a tribal link to Indian Brahmins (Sharma et al. 2009: 47).

Without going into further detail on the relationship between the Balto-Slavic and the Indo-Iranian branches, it is clear that migrations and cultural mixing of peoples originating in the area around the Dnieper River – and particularly its tributary, the Pripyat – played a major role in the broader spread of Core Indo-European culture. We argue that the geographical and hydrological features of Pripyat region played a decisive role in this spread. The conditions created in different parts of the vast Eurasian steppe are also crucial for the development of close connections and communication in the longer term. These intensive connections are often described as part of the broader concept of the Silk Road.

4. The Silk Road and east-west connections

The Silk Road concept and its meaning

The common use of the term 'Silk Road' is relatively recent and is widely attributed to the German geographer Ferdinand von Richthofen (1833-1905), who is believed to have coined the term 'Seidenstrasse' in 1877. Although there is no doubt that von Richthofen popularised formal use of the term, evidence suggests that it had been used in decades prior to his mention (Mertens 2019). However, it was Richthofen's most prominent student, the Swedish geographer and explorer Sven Hedin (1865-1952) (Fig. 11), who brought the name to global prominence with his eponymous 1936 book about Central Asian discoveries, published under the English title *The Silk Road* (Hansen 2015: 6-8). Importantly, the term 'Silk Road' cannot be considered to be an authentic historical name. Instead, von Richthofen chose it as a descriptive term, in reference to the sought-after fabric – but also many other luxury goods – that was exported from China to the West along various east-west trade routes across the Eurasian landmass.

As early as the second century BC, a range of luxury goods, including silk, were brought from China to the Mediterranean region via different caravan routes. Trade also flowed in the opposite direction, transporting glassware, jewellery and other prestigious objects from the Roman Empire and surrounding areas. In its classical form, the Silk Road dates back to the Chinese Han Dynasty (202 BC – 220 AC). This branch is also designated as the Great Silk Road, in order to distinguish it from other trade routes which can be incorporated into the broader Silk Road concept (Kuzmina 2008: 1-7).

During the Han dynasty, China extended its dominance towards the neighbouring Central Asian region, gradually bringing the region under unified control. As they developed control of trade networks, the Chinese also started to extend the Great Wall of China, a major defence work designed to protect trade routes. As China turned its interest westwards, there was also growing curiosity from the other direction. Following Alexander the Great's eastern conquests in the 4th century BC and the rise of Hellenism, a significant cultural interaction developed between the Mediterranean region and parts of Central and South Asia.

Fig. 11. Sven Hedin in Tibet (1907) with assistants. Source: Wikimedia commons. Author unknown. Public domain.

These contacts were further developed after the rise of the Roman Empire, which became China's western counterpart in the vast Silk Road trade network. It is important to note that the Silk Road was not a single fixed route, but a branched network of roads. The main route, the Great Silk Road, started in China's then-capital Chang'an – present-day Xi'an – and extended westward via the oases of the Taklamakan Desert, further through Central Asia towards Persia, Mesopotamia and finally the Mediterranean coast. Travelling the entire route usually took a couple of years, though most traders only travelled along shorter stretches, and goods were bought and sold on to intermediaries along the way, passing through several hands before reaching their destination (e.g. Liu 2010; Hansen 2015).

The importance of the Silk Road was manifold. Firstly, it enabled large-scale economic exchange, which contributed to strong economic

development at both ends of the route and in various locations along the way. But the route also had great cultural, religious and linguistic significance through the extensive interaction that took place during the economic transactions. The Silk Road's true heyday came during the Tang Dynasty, when a distinctive and rich culture developed along its routes, particularly in the areas that today constitute western China and Central Asia. It was during this period that Buddhism spread as a religion and cultural expression along the Silk Road, with the emergence of the Graeco-Buddhist Gandhara civilization – itself a continuity from the Hellenistic influence – in areas that today constitute parts of Afghanistan and Pakistan (e.g. Oestigaard 2005: 253-277; Foltz 2010: 42-51).

When Marco Polo made his famous journey along the Silk Road to the court of Kublai Khan in current-day Beijing at the end of the 13th century, the trade route was already in strong decline. The fall of the Tang Dynasty marked the end of the golden age of the classical Silk Road. The eastward spread of Islam transformed the once-flourishing Buddhist communities in the oases of the Taklamakan Desert and weakened the trade network. The Chinese finally abandoned the classical Silk Road during the Ming Dynasty (1368-1644) when the country cut its ties with the West (Hopkirk 1984: 19-31). The discovery of the sea route to India around the Cape of Good Hope in 1498 further diminished the role of the overland routes between South and East Asia and Europe, which were comparatively more time consuming. However, the caravan route through Central Asia continued to play an important role until the 20th century, as the Swedish geographer and explorer Sven Hedin noted (e.g. Wennerholm 1980).

A Viking Silk Road

In recent times, the term Silk Road has evolved and broadened to encompass the different branches, 'Silk Roads' or 'Silk Routes'. Instead of referring only to the traditional caravan route from China through Central Asia, this new designation covers the entire network of intricate land and sea routes that connect Central, East, South, Southeast and West Asia – and, by extension, also East Africa and Europe. This expanded definition includes the sea routes from China across the Indian Ocean, via Sri Lanka and India towards the Arabian Peninsula, the Persian Gulf and the Red Sea. So too can the more northerly land routes,

such as those running from western Central Asia and southern Russia through the river systems of present-day Russia and Ukraine. In these areas, the Rus' kingdom was established – probably in the 8th century – by people from what is now eastern Sweden. They controlled the river routes between the Baltic and the Black Sea until the 11th century AD. The classic Viking Age trade route from eastern Scandinavia, via the Baltic Sea and the territories of the Rus', is well documented and has increasingly been considered an extension of the broader Silk Road trade systems. The extensive finds of silk and other goods in Swedish and Norwegian graves – Birka and Oseberg being the most famous examples – strongly support this connection (e.g. Ostrom Peters 2002; Hedenstierna-Jonsson 2020; Larsson 2020). Although Viking Age contacts essentially coincide with the Silk Road's golden age during China's Tang Dynasty (618-907 AD), the contact routes between Scandinavia and regions as far as the Caspian Sea and beyond have a much longer history, as will be discussed below.

'The Baltic Sea can be considered, in many respects, to be the centre of the Viking world', says Ben Raffield. 'Throughout the Viking Age (c. 750–1050 AD), people, trade goods, and ideas flowed into its waters from regions as far removed as the British Isles, the Byzantine Empire and the territories of the Turkic tribes that inhabited the Eurasian Steppe' (Raffield 2020: 31). The Baltic Sea can in many ways be seen as a Northern Mare Nostrum, a hub connecting and not dividing people. Transport over sea was fast and efficient compared to travel on land, though bad weather was a challenge.

In 1994, an experimental journey with a copy of a small Viking vessel – a nine-metre ship with sail and oars – started from Sigtuna in Sweden, travelling up to 115 km a day to reach the port of Helsingfors in Finland in just 13 days (Edsberg 1994: 45). The 1,400-km journey from Sweden to Novgorod, 200 km south-east of St. Petersburg, took only 41 days. The journey from the Ladoga (east of St. Petersburg) followed the Volchov River upstream. The crew made the journey in two stages, completing the final leg in 1996. The ship descended the Dnieper to the Black Sea. Altogether, the ship travelled nearly 3000 km in 113 days, covering an average of 26 km a day, including rest days (Edsberg 1998: 7, 40).

The Vikings regularly travelled to Istanbul – at the time the Byzantine capital Constantinople – which they called Miklagard. However, they also made much longer journeys, for instance to the Caspian Sea along the Volga River (e.g. Androshchuk 2013).

Fig. 12. *Barge Haulers on the Volga* or *Burlaki* by Ilyan Repin (1870-1873). Russian Museum, St. Petersburg. Public domain.

Constantine Porphyrogenitus provided a detailed description of the journey down the Dnieper in *De Administrando Imperio*, emphasising it was a summer route (1967: 63):

> When the month of November begins, their chiefs together with all the Russians at once leave Kiev… to the Slavonic regions… and the rest of the Slavs who are tributaries of the Russians. There they are maintained throughout the winter, but then once more, starting from the month of April, when the ice of the Dnieper River melts, they come back to Kiev.

Although the natural course of the rivers was certainly exploited, manual labour and some overland portages were required, practices with historical roots. A central feature of bonded labour or slavery in Russia was the hauling of boats and barges along rivers, particularly the Volga. One of Russia's most iconic paintings by Ilyan Repin (1870-1873), *Barge Haulers on the Volga* or *Burlaki*, portrays the hardship and suffering of hauling boats (Fig. 12). This method of upstream transport was common (Fig. 13), even during the Viking period, as described by Constantine (1967: 59-61):

> At this barrage all put into land prow foremost… The remainder, taking up the goods which they have on board the 'monoxyla' [boat], conduct the slaves in their chains past by

land, six miles, until they are through the barrage. Then, partly dragging their 'monoxyla', partly portaging them on their shoulders, they convey them to the far side of the barrage; and then, putting them on the river and loading up their baggage, they embark themselves, and again sail off in them.

Fig. 13. Das Treideln auf der Havel (Towing on the Havel) from the journal *Die Gartenlaube* (1890), p. 501. By Zeichnung von B. Stöwer. Public domain.

Following the course of rivers was practical for rapid and efficient transport, also of heavy goods. Having fresh water in the vicinity also offered other advantages, including providing food and water for both the crew and, more importantly, their livestock. Because while humans need around 2 litres of water (or beer) per day, a horse or a cow typically needs 15-30 litres a day (Cooijmas 2021: 194). Travelling with animals would have required continuous proximity to water bodies to ensure regular and sufficient water supplies. While this was a critical factor for Viking expeditions, it was even more vital for pastoral groups. As a hypothetical estimate, a pastoral group of 50 people with 10 horses and 25 cows would have required between 625 and 1,150 litres of water per day. Access to water was essential during the daily grazing, but even more so during migrations.

This meant that migration routes that deviated from rivers or watercourses would have jeopardized the survival of the entire herd. If a group of this size needed around 1,000 litres of water a day, even short-distance migrations through areas without reliable water resources would pose a serious risk. Long-distance migrations in areas without water would have been like Russian roulette. From a risk mitigation perspective, the most viable migration routes followed rivers and waterways.

The Viking expeditions were conducted in summer, when they could sail, and not during the winter season, when the rivers were frozen. The early Indo-Europeans, who lived 4-5000 years ago, did not have the same social organization and societal structure, technological capacity and access to unfree labour. Moreover, the early Indo-European journeys had a different purpose: migrating and moving the herd to areas with better pastures. Thus, practically and technologically, it would have been better for these groups to use the rivers in other ways.

This also raises a broader question: to what extent did the Vikings build on millennia-old knowledge of Eurasian river systems? The fact that the Vikings were active across the Eurasian continent from 800 AD – not only in the Black Sea but also the Caspian Sea region – may indicate that they built on existing knowledge of established trade and travel routes, that had been known and used for centuries.

Bronze Age routes between eastern Scandinavia and the Volga-Kama area

There is strong evidence that the routes used by the Vikings long predated the Viking Age. Findings suggest contact between eastern central Sweden and the so-called Ananino culture – centred in the regions around the Volga and Kama rivers in present-day Russia – occurred as early as the Scandinavian Late Bronze Age (8th-9th century BC). The Ananino cultural space was primarily concentrated around the Kama River and its tributaries, extending to the confluence with the Volga River. However, as a collective term for cultural groups with common denominators, Ananino culture covered a significantly larger area, stretching to the east and north-west towards Russian Karelia. The culture is usually dated to around 700/600–200 BC, though precise dating remains contentious, with some scholars arguing the culture flourished during an earlier period.

Archaeologists have for more than a century observed similarities between the Volga-Kama area and Scandinavia, though few have delved further into these findings. Archaeologist Karin Ojala (2016) has examined the eastern contacts during the East Scandinavian Bronze Age, focusing on bronze axes reminiscent of those found in the Volga-Kama area and on Baltic-type ceramics. Mälardalsyxor (Lake Mälaren Valley axes) and Ananino axes, respectively found in eastern and northern Sweden have also been found in Russia's Volga-Kama area, where they apparently originate (Fig. 14). Earlier Swedish research interpreted these contacts as a form of early 'Viking expeditions' towards the interior of present-day Russia (Nerman 1954), while more recent interpretations rather advocate for impulses from Russia to the west.

Already in the first decades of the 20th century, Finnish and Swedish archaeologists linked the spread of these bronze axes to intensive contacts between the Volga-Kama region and eastern central Sweden. These findings were often interpreted as early colonization attempts by Scandinavian groups (e.g. Tallgren 1916; Nerman 1918).

The culmination of this theory was an article by Birger Nerman (1954), who made a direct analogy between these prehistoric movements and the later Viking raids. In addition to his theories on Scandinavian colonies in the Volga-Kama region, Nerman (1942, 1954) also explored contacts with the Caucasus, as indicated by certain bronze objects (Fig. 15).

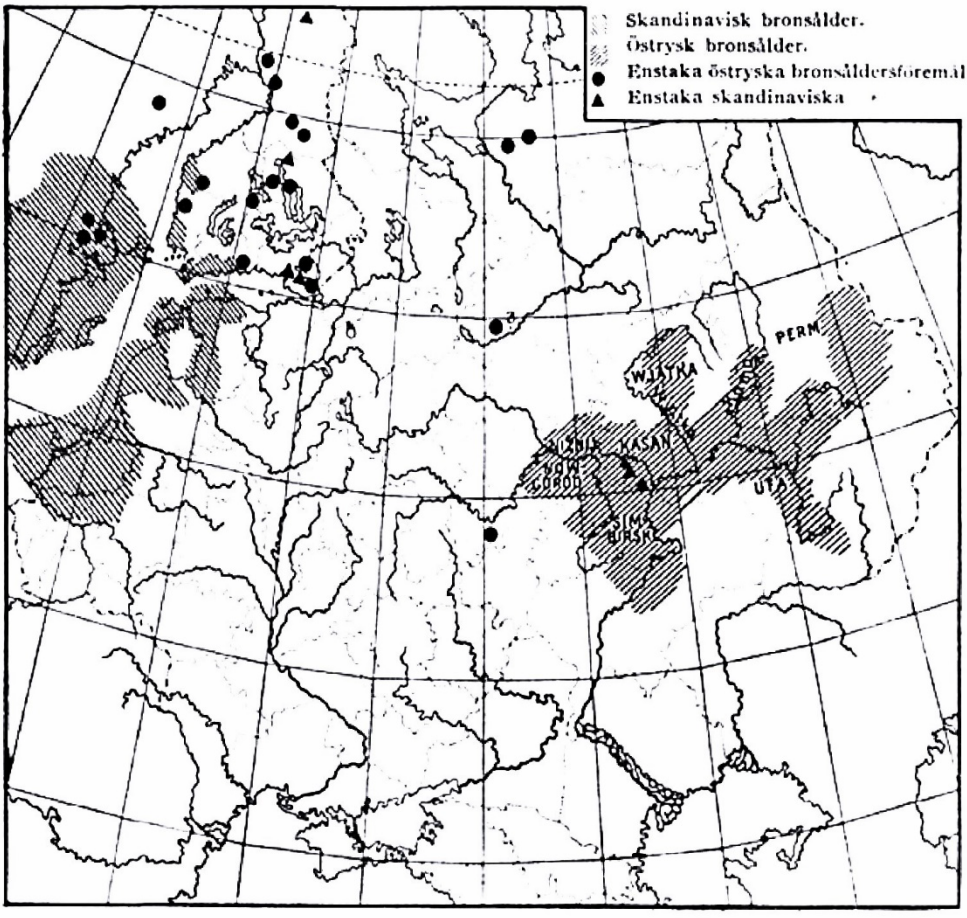

Fig. 14. 'Scandinavian' and 'east Russian' Bronze Age cultures. From Tallgren 1916: 364.

The exploration of these contact routes has once again become highly relevant, but not because of early 20th-century nationalistic interpretations. In addition, the Viking Age is increasingly used as a clear analogy for the interpretation of the Nordic Bronze Age (e.g. Ling, Earl & Kristiansen 2018). What has been less often explored, however, is the possibility of extending these analogies further back in time – viewing the connections between Scandinavia, the Baltics and areas in southern Russia and Central Asia as ancient phenomena dating back to early Indo-European migrations.

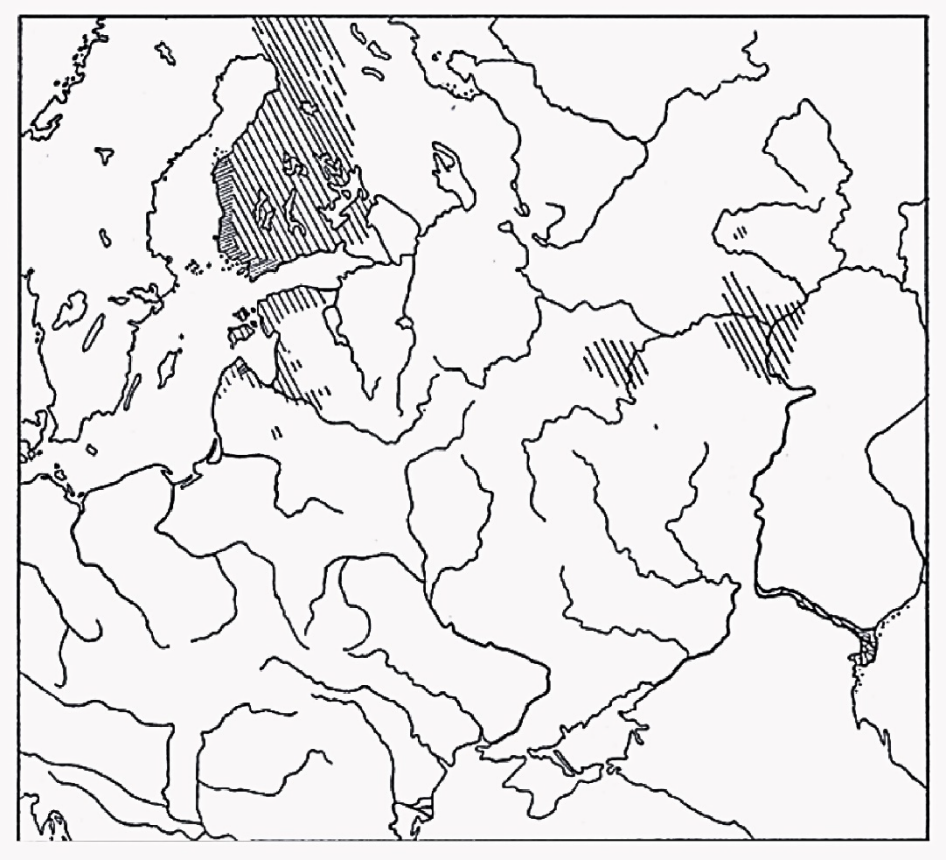

Fig. 15. Map by Nerman (1954: 265) showing the Swedish expansion eastwards during the Late Bronze Age and what he called 'the first Swedish Viking period'. Note that the contacts follow the Volga River to the Kama region.

As we strongly argue throughout this book, waterways were crucial in shaping contact and travel routes. For the Viking Age, there is relatively detailed evidence of this, especially with regard to the rivers running through present-day Russia and Ukraine. However, it is highly likely that hydrological networks played a central role in earlier periods, as suggested by the contacts described above. From the Bronze Age onwards, almost all major trade routes 'were located along the valleys of the Volga, the Kama and the Ural's basins and, thus, ran along the watersheds of their numerous tributaries' (Bezrukov 2015:55).

Long-distance contacts between Scandinavia and the Volga-Kama region can thus be understood not only in light of Viking Age contact routes, but also as part of a broader and older network of waterways that

shaped earlier interaction. This hydrological perspective also applies to the connections across the Baltic Sea, which were crucial for Scandinavian ties with the East. Along Finland's west coast and in the southern Baltic – particularly present-day Estonia – Swedish-speaking settlements can be traced back at least to the early Middle Ages. However, there is also substantial evidence of a significantly earlier settlement phase. Early 20th-century archaeologists strongly supported the latter interpretation, but it has also received more recent, renewed support (e.g. Kaliff 2001; Markus 2004). Close ties between the coastal regions along the Baltic Sea were, in fact, a natural outcome of the period, as waterways were by far the fastest and most efficient means of transport until the advent of industrialization and the railway.

The Late Nordic Bronze Age (c. 1100-500 BC) was generally characterized by close interaction between eastern Scandinavia and the Baltic region, as reflected in pottery finds from this period (Jaanusson 1981: 120-130; Reisborg 1989: 83-106; Eriksson 2009: 247-252). In his studies of stone ship burials in the Baltic Sea area, Joakim Wehlin argues that there was a shared maritime culture during the Late Bronze Age (Wehlin 2013: 163-195). The same interpretation can be applied to other monumental grave forms, such as burial cairns in the coastal regions of Sweden and present-day Finland. The development of settlements along the Finnish coast also occurred following intensive exchange with the South Scandinavian Bronze Age culture (Holmblad 2010: 41-48, 147-157; Jansson 2011: 117-148). The interaction between the coastal regions around the Baltic Sea was extensive, and, in some cases created the conditions for intensive exchange and even migration.

Travel by sea took time but was often easier and safer than travel over land. Shipping also enabled larger and heavier loads to be transported and while piracy formed a threat, travellers over land faced greater risks. Rough seas and bad weather could also make journeys across the Baltic Sea dangerous, which was why sailors opted for the relatively more secure routes, for example sailing to the Baltic coast via Gotland to minimize travel across open sea. The safest route ran from a port near present-day Stockholm passing the island of Åland and other small isles to the Finnish archipelago, skirting the coast into the Gulf of Finland and from there inland via the rivers and lakes in present-day Russia (Markus 2004: 102-107).

Thus, we can establish that the Baltic area, including Scandinavia, can be seen as an extension of the Silk Road. The prehistory of the Silk Road is not limited to the Viking Age, but has roots already in the

Bronze Age. There is little doubt that routes and transport routes that are direct predecessors to the historically known, classical Silk Road, began functioning as early as the Bronze Age (Kuzmina 2008: 3, 108-114).

'Silk Roads' before the Silk Road

While the classical Silk Road was established only during China's Han Dynasty in the 2nd century BC and the modern concept of the Silk Road is even more recent, East-West contact routes have longer historic continuities. They date back as far as the 4th millennium BC and the spread of Core Indo-European languages and cultures.

A key factor enabling the relatively swift travel along the classical Silk Road was, of course, the vast Eurasian steppe – a continuous expanse that stretches approximately 8,500 km from the Hungarian Plain in the west to the Great Wall of China in the east. While the steppe may seem to offer a straightforward and rapid route, in practice it presents significant challenges. Several wide rivers bisect the steppe in Eastern Europe, and Central Asia – the heartland of the classical Silk Road. The natural geography here is extremely varied:

> The vast territory of Central Asia is surprisingly diversified in its climate and landscape (deserts, dry Steppe, foothills, mountainous areas, fertile oases), which has meant that there have been great variations in the pace and course of the cultural development of different parts of Central Asia (Kuzmina 2008: 71).

Studies of aDNA have shown the rapid Early Bronze Age expansion of groups from the western Eurasian steppe. The earliest long-distance migration patterns date back to the emergence of the Afanasievo culture in the easternmost regions of the steppe. This culture is named after the Gora Afanasieva Mountain in the Minusinsk Basin in southern Siberia, where Russian archaeologist Sergei Teploukhov excavated the first site in the 1920s. While the original site on the Yenisei River was submerged by the Krasnoyarsk Reservoir in 1960-67 (Svyatko et al. 2009), many other sites have been identified since.

Research has shown that the Afanasievo culture (c. 3100-2500 BC) descended from the Yamnaya culture (Poliakov et al. 2019). It rapidly spread over a large area, from the Altai in the south to Dzungaria in Xinjiang, just north of the Tarim Basin (Kuzmina 2008: 95; Pilipenko et

al. 2020). While the culture was mainly concentrated in the region from the Minusinsk Basin to Dzungaria, Afanasievo burial sites were also found up to 1,500 km east of the Altai in central Mongolia (Choongwon 2020). Recent empirical evidence – despite the time gap – provides a compelling picture of the speakers of the now-extinct, Core Indo-European Tocharian language. Although first documented in the 1st millennium AD, Tocharian most likely originated in the Afanasievo culture. Following the linguistic model of the earliest split of the Core Indo-European languages separating Tocharian from the rest of the Core Indo-European variants: '...Tocharian may have been plausibly introduced to the Dzungarian Basin by Afanasievo migrants during the Early Bronze Age...' (Zhang et al. 2021). It is therefore also of interest that DNA evidence shows that the Afanasievo legacy remains the most distinctive marker of western genetic influence, even in present-day Xinjiang (Wang et al. 2023), strongly suggesting a degree of demographic continuity dating back to the Bronze Age.

Around the same time (c. 2950 BC) that the Afanasievo culture emerged in the east, its close relative, the Corded Ware culture, appears in Central and Northern Europe thousands of kilometres to the west. Both groups were direct descendants of the Yamnaya culture, and their close genetic proximity has been clearly proven. Despite the vast geographical distance between the Corded Ware culture of Northern Europe and the Afanasievo in the Altai region, they share common ancestry only a few generations back:

> We find that the Bronze Age in Asia is equally dynamic and characterized by large-scale migrations and population replacements. The Early Bronze Age Afanasievo culture in the Altai-Sayan region is genetically indistinguishable from Yamnaya, confirming an eastward expansion across the steppe... in addition to the westward expansion into Europe. Thus, the Yamnaya migrations resulted in gene flow across vast distances, essentially connecting Altai in Siberia with Scandinavia in the Early Bronze Age (Allentoft et al. 2015: 169).

These contact routes were equally relevant in the slightly later eastward reflux of the Corded Ware/Middle Dnieper culture, via the Fatyanovo-Balanovo culture. This important event eventually resulted in the development of Sintashta culture in the steppes of southern Russia and Kazakhstan around 2200 BC, which was of great historical significance. The rapid spread of the domesticated horse, specifically the breeding

lines that would come to dominate globally, as well as key technical innovations such as the chariot and metallurgy, can all be traced back to the Sintashta culture. The westward spread of influences from the Sintashta culture was probably driven less by migration than by the transmission of ideas along established contact routes, among groups that, at this stage, probably still shared a relatively high level of linguistic and cultural similarity. In any case, the use of horse-drawn chariots spread to Scandinavia within a century or two of their initial development on the steppe. This is clearly evidenced by the sacrificed bronze pieces of a chariot in the Danish bog of Gallemose (e.g. Price 2015: 182, Randsborg 1992, Vandkilde 2017: 113).

Fig. 16. The Kivik grave in southern Sweden. Detail from slab 7. Documented by Andreas Toreld and Sven-Gunnar Broström. Source: www.shfa.se

Fig. 17. The finds from Gallemose in Denmark. Chariot remains in right lower corner. The National Museum of Denmark, Copenhagen. Creative Commons.

The domesticated horse is generally believed to have arrived in Scandinavia in the early Bronze Age. It was a prestigious form of livestock, as well as a powerful religious symbol, closely associated with rituals and the practice of chariot riding. Rock carvings in Sweden and Norway depict light two-wheeled chariots – the most famous of these was found in the burial chamber of the Kivik cairn, dated approximately 1500 BC (Fig. 16). The Gallemose find (Fig. 17) indicates that the light two-wheeled chariot with four-spoked wheels reached northern Europe and Scandinavia much earlier than previously assumed, appearing not long after its original invention in the Sintashta culture. This suggests that there was a more direct contact route between northern Europe and the steppe region. Dated as early as 2000 BC, the Gallemose find provides strong evidence to support this. The classic chariot is commonly defined as a light – about 30 kg – spoke-wheeled vehicle, drawn by two or more horses. It differs significantly from the older heavy four-wheeled wagon.

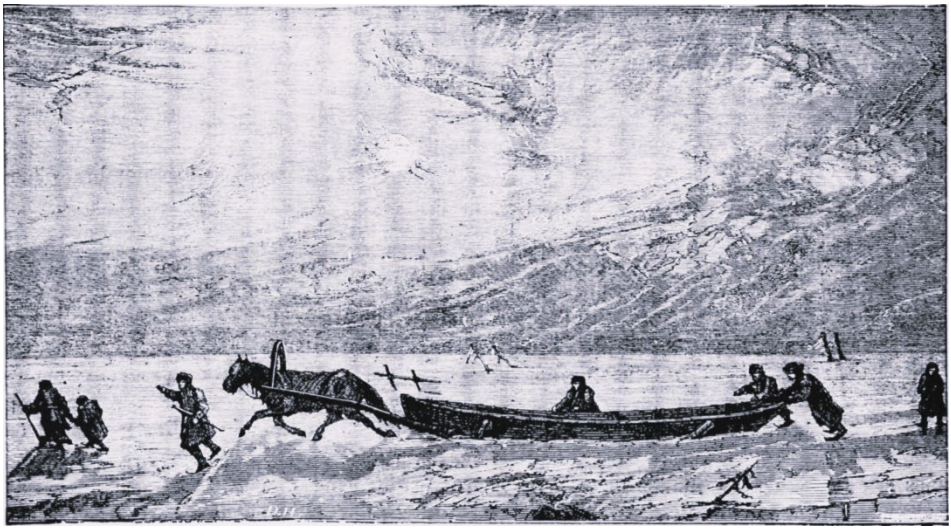

Fig. 18. Sledge boat on the frozen Volga River. From Ridpath 1896: 142.

After their invention in the Sintashta culture, chariots appear in the Near East from c. 2000 BC and in India after around 1700 BC (Witzel 2019: 58), highlighting the great significance of the Gallemose find. It also raises the question of where and how such chariots would have been used in the Scandinavian landscape. Given the absence of proper roads, it would have been difficult to drive such a chariot across open fields. One plausible route for swift travel may have been frozen lakes and rivers, which, in historical times, served as fast and efficient highways. Horses were even used to pull boats like chariots across these frozen waterways (Fig. 18).

The Seima-Turbino phenomenon

An important early culture in the context of rapid, long-distance interaction across the vast Eurasian expanse is the so-called Seima-Turbino culture – also referred to as the Seima-Turbino phenomenon. This term reflects the complex nature of the culture, which appears to consist of multiple, possibly distinct, ethnic groups – particularly in its later phases – engaged in a dynamic network of intensive exchange. Originating in the Altai region around 2200 BC, the Seima-Turbino culture migrated westward around 2000 BC and came to dominate the Ural region until around 1800 BC. The culture is defined primarily by its

burial sites with bronze artifacts similar to those found across northern Eurasia – from Fennoscandia in the west to Mongolia and northern China in the east. The Altai Mountains are considered to be the homeland of the Seima-Turbino culture, which has its roots in the Afanasievo culture, the first Core Indo-European offshoot of the Yamnaya culture (Marchenko et al. 2017; Childebayeva, et al. 2023; cf. Anthony 2007: 447).

The Seima-Turbino culture is primarily known for its bronzes, particularly its weaponry – early versions of which were made of copper alloyed with tin from the Altai Mountains. The use of tin as an alloy for bronze is an important innovation ascribed to the Seima-Turbino culture. Earlier production of the metal in the Eurasian area involved alloying copper with arsenic or other metals. However, it was during this period that the classic bronze alloy came to dominate (Lin 2016: 242-247). This shift marked a turning point, not only in Bronze Age Europe, but also, significantly, in the Chinese Bronze Age, known for its rich bronze production. Striking similarities have been noted between Seima-Turbino artifacts and those of the Chinese Shang dynasty, including socketed spearheads with single side hooks, jade figurines and knives with deer-headed pommels. This suggests that the Seima-Turbino culture played a pivotal role in introducing bronze metallurgy to China, while simultaneously spreading this technological knowledge westward. This pattern is strongly reminiscent of the Silk Road we know from ancient history: 'The discovery of the Seima-Turbino culture in China is of great importance, as it demonstrates with material evidence that Chinese metallurgy derives from the cultures of the Eurasian Steppe' (Lin 2016: 256).

In the southern Urals, the Seima-Turbino culture comes into close contact with the influential Sintashta culture (c. 2200-1800 BC), which is also associated with the spread of important innovations. Like Seima-Turbino culture, the Sintashta culture is known for its bronze production. Excavations have shown that every other house within its characteristic fortified settlements contained evidence of bronze production sites. This was made possible by the rich copper and metal deposits found in the Ural Mountains, which the Sintashta people mined. Centred just south of this range, the Sintashta culture, along with the Seima-Turbino, was of great importance for the dissemination of bronze metallurgy. Recent aDNA analyses of domesticated horses associated with the Sintashta culture have shown that they were the ancestors of nearly all domesticated horses alive today (Librado et al. 2021). It is also within the Sintashta culture that the fast, two-wheeled

chariot was first developed, an innovation that rapidly spread across the Eurasian steppe and into the Middle East. The Sintashta culture also played a key role in the further dissemination of bronze metallurgy. Moreover, aDNA analyses have confirmed that the Sintashta culture was the point of origin for the Indo-Iranian cultural and linguistic group. This southward expansion ultimately reached northern India and Iran, giving rise to the Vedic culture and the ancient Persian civilisation, respectively (Narasimhan et al. 2019).

The Seima-Turbino culture – or phenomenon – can thus be regarded as a precursor to the Silk Roads. Its influence appears to have extended across vast areas of Eurasia, from China in the east to northern Europe and the Mediterranean in the west. Notably, there are indications that the Greek and Mycenaean cultures had their roots in, or were significantly influenced by, the Seima-Turbino phenomenon. This is supported by aDNA analyses (Lazaridis et al. 2017; Skourtanioti et al. 2023) showing that Indo-European groups within the Yamnaya culture were ancestral to these populations. Recent studies indicate that the steppe component in the Bronze Age Greek genetics originated directly from Yamnaya-related populations. This lineage differs from that of the Corded Ware populations, who were formed by the mixing of Yamnaya groups with European Neolithic farmers associated with the Globular Amphora culture, which were widespread across most of the rest of Europe (Yediay et al. 2025).

The ancestors of the Bronze Age Mycenaeans probably migrated from the western steppes towards Greece from c. 1900 BC, where they mixed with earlier local cultures, forming the Mycenaean civilization. Archaeologically, Mycenaean chariots, spearheads, daggers, cheek-pieces for horses and other bronze objects show striking similarities with the Seima-Turbino culture of the Russian forest-steppes, which was also known for the great mobility of its warriors who moved on horseback and in chariots (Mallory & Adams 1997: 91-92; Anthony 2007: 369). The latter is a clear sign of the aforementioned close interaction with the Sintashta and Seima-Turbino cultures and may explain the rapid and broad spread of Sintashta innovations. In addition to the supposed ancient origins in Altai and Afanasievo, some scholars have suggested that the Seima-Turbino culture emerged as a result of interaction between the Abashevo culture, the Catacomb culture and the early Andronovo culture (Kuzmina 2008: 253). These cultures could, to a certain extent, be included in the overall Seima-Turbino phenomenon. This would make the Seima-Turbino complex a veritable high-

way for the transmission of Indo-European cultural elements across a very large geographical area.

The Seima-Turbino phenomenon is also of great interest in the context of the previously discussed early connections between the Volga-Kama, Baltic and Eastern Scandinavian regions. Although these connections predate the eastern contacts during the Late Nordic Bronze Age, they can still be seen as an earlier phase of continuing long-distance contact networks between the Volga and Ural regions with north-western Russia, the Baltics and Fennoscandia. Both the contacts between the Baltic Sea area and the Ananino culture as well as the Seima-Turbino phenomenon are linked to the spread of bronze crafts and objects such as axes and daggers from Siberia in the east to Scandinavia in the west (Ojala 2016: 139-141 with references).

These examples clearly establish the longstanding importance of contact routes across the Eurasian steppe and beyond. Long-distance and extensive migration of groups – beginning with the pastoral Yamnaya culture at the end of the 4th millennium BC – created a demographic pattern that facilitated subsequent interactions. As carriers of the Core Indo-European language, the Yamnaya migrants quickly formed dominant groups that spoke the same or closely related languages across geographically distant areas. The strong linguistic similarities are likely to have persisted for several centuries and played a significant role before processes of hybridization and dialectification changed these conditions. This would have greatly facilitated both communication and further migration. Thus, the initial Yamnaya expansion may require a somewhat different explanation than later waves of migration and contact, even if the geographical areas are the same. Nevertheless, the natural geographical and climatological conditions remained largely unchanged over time – including factors that are particularly relevant to understanding the movements of pastoral peoples across the Eurasian area. To gain an insight into how early Indo-European pastoralists may have lived, we can examine one of the best-documented pastoral groups in European history: the Scythians.

5. The Scythians as nomads and warriors

Historical background

The Scythians were a fascinating group of pastoralists and nomads of the Eurasian steppe, particularly notable for being extensively documented by the classical historian Herodotus in *The Histories*, written in the 5th century BC. The Scythians represent a continuity with earlier steppe cultures, primarily – though not exclusively – Indo-European. The Cimmerians and Scythians succeeded the definitively Indo-European Srubnaya culture, itself a successor to the Sintashta culture and most likely closely related to the Andronovo culture.

> The exact origin of the Srubnaya culture continues to be debated, but so much is clear that it derives either from the Sintashta culture or from the related cultures of the Volga steppes… The Srubnaya culture is closely similar to the Andronovo cultures, and there was a constant contact between them. I am revising my archaeological-linguistic correlations by placing the end of the Proto-Indo-Iranian period to around the twentieth century bce, when the Sintashta and related cultures of the Volga-Ural steppes developed into the Proto-Iranian-speaking Srubnaya cultures of Eastern Europe and into the Proto-Indo-Aryan-speaking Andronovo cultures of the Asiatic steppes (Parpola 2020: 190).

The Srubnaya culture itself was the follower of the earlier Catacomb culture in the western part of the Pontic steppe and the more eastern Poltavka (Mallory & Adams 1997: 541-42). The Srubnaya, the Alakul and the Fedorovo cultures, all considered variants of the overall Andronovo culture, are likely to have spoken Indo-Iranian languages, particularly the Srubnaya culture, '… the ancestors of the Sacae, the Scythians, and the Sarmatians' (Diakonoff 1995: 473). Nevertheless, the Scythians have rarely been used as an entry point into the world of early Indo-European nomadic societies, most probably because they were not considered to be a purely Indo-European phenomenon. However, if we look at geographical conditions, living environments, material culture and economic structures, the Scythians provide a highly suitable analogy.

Fig. 19. Artistic reconstruction of a Scythian nomad. Author: Simeon Netchev (CC BY-NC-ND).

This is especially relevant given that large segments of the populations grouped under the term 'Scythian' probably spoke Indo-European languages. From this perspective, Barry Cunliffe's *The Scythians. Nomad Warriors on the Steppe* (2019) forms a valuable academic contribution that makes this field of research more accessible.

The Scythians lived in the first millennium BC – primarily around 700-200 BC. They were great horsemen and warriors, dominating the Eurasian steppes from the Hungarian Plain in the west to the Altai Mountains in the east, in the same area where the Yamnaya culture had developed nearly three millennia earlier (Figs. 19 & 20). They can be related to the Andronovo culture, itself a continuation of Sintashta. Like Andronovo before them, the Scythians are thought to have been of Iranian origin. One of their core regions was the Pontic steppe where the early Yamnaya culture had previously emerged – stretching north of and between the Black Sea and the Caspian Sea – an area often identified as the original homeland of the early Core Indo-Europeans. This geographical and temporal proximity, combined with shared economic and cultural features and adaptative strategies, offers a valuable insight into the lives and cosmology of the early Indo-European pastoralists (Cunliffe 2019).

Fig. 20. A gold find from Kerch, c. 475-450 BC showing Scythians shooting with bows. Source: Wikipedia. Photograph taken PHGCOM. License: (CC BY-SA).

The Eurasian steppe corridor from Hungary in the west to Manchuria (north-east China) in the east spans approximately 8,000 km. According to Barry Cunliffe's description: 'For the most part the steppe corridor is gently undulating land broken only by the great rivers flowing across it, some northwards into the Arctic Ocean, others southwards into the Caspian Sea and the Black Sea. But at two points mountain ranges hinder east-west progress' (Cunliffe 2019:64). Mountains, not rivers, were seen as obstacles to rapid east-west travel. Perceptions of the speed at which pastoral groups travelled may have been influenced by deceptive Mongol accounts from the 13th century AD. They reported that a Mongol rider setting off from the Mongol capital Karakorum could reach Hungary within a month. However, at an average pace of just 25 km per day, such a journey would actually take closer to a year on horseback. Nevertheless, the flat expanse of the steppes and the central role of the horse certainly facilitated movement over large distances (Cunliffe 2019: 64-65).

Fig. 21. A golden pectoral found in a Kurgan burial from Tovsta Mohyla, 4th century BC. National Historical Museum of Ukraine. Public domain.

Warriors on horses travelled more easily and swiftly, following the narrow corridors along riverbanks. However, pastoral nomads faced greater challenges, as travel with livestock is slow. Cows are slow-moving animals, and the pace of a migrating herd naturally sets its own rhythm. Moreover, for the Scythians, the wagons served as homes for the herding population (Cunliffe 2019: 211). This was probably also true for the pastoralists of the Yamnaya culture around 3000 BC, although they may have used tents for shelter. While the use of the horse as a draft animal appears to have emerged later – mainly with the Sintashta culture (cf. Librardo 2021), the people of the Yamnaya culture made extensive use of slow ox-drawn carts. As a technological and social invention, the cart – which preceded the Yamnaya culture and probably

emanated from Neolithic Europe – made life easier, more practical and comfortable for nomadic cattle herders. Everything needed for daily life – including the home itself – could be transported at roughly the same pace as the cattle herd, always available and ready for use.

The combination of pastoralism and skilled warfare, moreover, could prove to be a highly lucrative business (Fig. 21). From a strategic military point of view, 'The crucial thing they have discovered is how to prevent anyone who attacks them from escaping, and how to avoid being caught unless they want to be detected. Since they have no towns or strongholds, they carry homes around with them on wagons, since they are all expert at using their bows from horseback, and since they depend on cattle for food rather than cultivated land, how could they fail to be invincible and elusive?' (*Hist*. 4.46).

The combination of cattle and wagons allows for a particular type of adaptation and way of life, but it also reduces the speed of migration and distances covered. Instead, it favours shorter north-south movements along rivers and waterways, where the animals' needs for abundant water and fodder can be met. From a physical and material standpoint, cows and wagons behave in rather similar ways: both are unsuited to winter conditions with deep snow and are ineffective in swampy or muddy areas, especially during the mud season along the major rivers of Russia and Ukraine. Without boats, pastoralists cannot cross rivers with wagons during the summer, making such crossings possible only in winter when the waterways are frozen. In brief, when discussing pastoral groups, the possibilities for migration and movement differ significantly between nomads and mounted warriors travelling without livestock, wagons or any other encumbrance. The latter can move rapidly over long distances on horseback, almost regardless of the terrain. In contrast, the mobility of the former is constrained by the slower pace of cattle, their need for water and fodder, and the limited speed at which heavy wagons can be pulled through the landscape.

Herodotus and the Scythians in *The Histories*

The fifth-century BC historian Herodotus is often called the 'Father of History', although some have also labelled him the 'Father of Lies' due to the subjective nature of his accounts and the influence of his Greek perspective (Taylor 1998: 374). However, Herodotus himself said: 'I am obliged to record the things that I am told, but I am certainly not

required to believe them – this remark may be taken to apply to the whole of my account' (*Hist*. 7.152). His perspective and approach to documenting and recording history is comparative, contrasting unknown worlds and people with the familiar Greek context. In doing so, he generates new knowledge and understanding by highlighting contrasts and differences.

> The Scythians blind all their slaves, and this is connected with the milk that they drink. The way they get their milk is as follows. They have blow-pipes made out of bones (they look very like our reed-pipes), and while one person inserts one of these pipes into the vagina of a mare and blows into it, someone else is doing the milking. They say that the effect of this is that the mare's veins are pumped up and the udder descends. Once the milk has been extracted, it is poured into deep wooden vessels and then they station their blind slaves around the vessels and have them stir the milk. The milk separates into an upper layer (which is skimmed off and regarded as the best bit) and a lower layer (which is thought to be less good), and that is why the Scythians blind everyone they capture. For they are nomads, not farmers (*Hist*. 4.2).

The method of milking described by Herodotus is a commonly used technique where the herder blows into the cow's vulva or anus to stimulate milk flow, making this a credible piece of information. Whether or not the slaves were blind, as he claims, remains uncertain.

Herodotus shows particular interest in the ecology and water-world of the Scythians in the Black Sea region, with detailed descriptions of rivers:

> The land there is flat, grassy, and well watered, and there are almost as many rivers flowing through it as there are canals in Egypt. I will list the most notable rivers – that is, those which can be sailed up from the sea. There is the Ister [the Danube River] with its five mouths, then the Tyras [the Dniester River], the Hypanis [the Bug River], the Borysthenes [the Dnieper River], the Panticapes [probably the Samara River, a tributary to Volga], the Hypacyris [A river in European Sarmatia], the Gerrhus [The Molochna River], and the Tanaïs [the Don River] (*Hist*. 4.47).

In Ukraine,

> the Borysthenes [the Dnieper River], which is the largest of these rivers after the Ister [the Danube River], and is, as far as I can tell, not just the most productive river in Scythia, but in the whole world – with the exception of the Nile in Egypt which cannot be compared with any other river in this aspect. But apart from the Nile, the Borysthenes is the most productive river. It not only provides wonder-ful, lush meadows for cattle, but outstandingly fine fish as well, in very large quantities as well; its water is clear where other rivers are muddy, and makes lovely drinking-water; the crops that grow on its banks are excellent, and where the land is uncultivated grass grows to a great height (*Hist*. 4.53).

However, despite all the riches and the bountiful pastures, this region was harsh, with devastatingly cold winters.

> All the lands I have mentioned experiences very severe winters – so much that for eight months of the year it is gripped with intolerable frost. During these months you cannot make mud by pouring water on the ground, but only by lighting a fire. The sea near the cost freezes over, as does the whole of the Cimmerian Bosporus, and the ice can bear the weight of the Scythians living inside the boundary of the trench, who go on military campaigns driving their wagons across it as far as Sindica. So a winter of this severity lasts for eight months, and for the remaining four months it is still cold there. Winter in this part of the world is also different in kind from winters anywhere in the world, in that it hardly rains at all, as one would expect in this season, but in summer it never stops raining… Horses can bear winter here, but mules and donkeys cannot do so at all, whereas elsewhere horses develop frostbite if they stand on frozen ground, while donkeys and mules can put up with it (*Hist*. 4.28).

Herodotus provides valuable information about the winter climate and the opportunities offered by frozen water landscapes. In winter, the Scythians conduct military campaigns, crossing vast bodies of water with their wagons, as the ice can support the weight. In contrast, during summer, heavy rains make such travel impossible, and the terrain

becomes very muddy. However, Herodotus also notes that winter can be an obstacle that restricts movement.

> What about the feathers with which, according to the Scythians, the air is filled with, and which stop them either seeing or travelling over more of the continent?... snow does look like feathers, as anyone who has ever seen snow falling thickly from close up can confirm; so I think that the Scythians and their neighbours are describing the snow metaphorically as feathers (*Hist*. 4.31).

It is clear that moving through deep snow across fields and hilly terrain with cattle, horses and wagons is difficult or even impossible. Therefore, the winter perspective should focus on crossing water bodies and following the natural flow where snow can be cleared if needed to create flat ice roads suitable for both for animals and wagons. From this perspective, large rivers – initially seen as major obstacles to large-scale migration or the movement of herded cattle – transform into practical 'highways', enabling rapid and extensive travel. A modern analogy can be found in the use of winter roads on the frozen rivers of Siberia, as well as on the vast, frozen surface of Lake Baikal in Russia. These are just two examples but they clearly illustrate a broader historical pattern.

6. Ecology and cattle

Economy and ecology of cattle and pastoralists

In *On Agriculture*, the Roman scholar Marcus Terentius Varro writes: 'there is a science of assembling and feeding cattle in such fashion as to secure the greatest returns from them; the very word for money is derived from them, for cattle are the basis of all wealth' (Varro, n.d, p. 319). Owen Lattimore has another approach: 'This lays bare a truth which is at the core of all steppe-nomadic history: it is the poor nomad who is the pure nomad. When they have modified their economy, their society and above all the status of their chiefs, nomads become vulnerable' (Lattimore 1938: 15).

This perception, that only the poor nomad is the 'true' nomad, may be valid in certain barren areas in historical contexts, particularly in regions adjacent to powerful empires, such as Mongolian pastoralists near Chinese civilization. However, in most cases, cattle and pastoralism have generated considerable wealth and well-being for herders as well as agriculturalists who utilized all the resources provided by cattle.

The fact that cattle play a key role in the Indo-European creation myth is, in itself, a clear indication of their foundational importance. Cattle and the well-being of livestock lay at the heart of how existence was understood and structured, shaping both social structures and religious beliefs. As Bruce Lincoln puts it:

> Cattle were the very basis of the I-E economy, forming the essential measure of wealth and means of exchange. The animals supplied milk and meat, the main elements of the food supply; hides for clothing, blankets, bags, and shields; bones for tools; dung for fuel; and urine for disinfectant. They were also crucial to the social order, serving as bridewealth and wergild. Society itself was understood as the collectivity not of only men, but of 'men and cattle' or 'bipeds and quadrupeds'. Given this enormous importance of cattle within the socio-economic order, it comes as no surprise that the Indo-Europeans were always interested in preserving the cattle they had and in procuring more. Their prayers are filled with requests for cattle,

> and cattle raiding seems to have been one of the most important pursuits of the warriors (Lincoln 1976: 62-63).

Importantly, one may also address ecological changes and adaptation processes from the perspective of the Secondary Products Revolution and the advantages this offered for nomadism, transhumance and farming in early societies:

> These secondary products had important applications both in the intensification of agricultural production and in the sphere of transport, trade and personal mobility. The plough increased production and made economic the cultivation of a range of poorer-quality soils; it thus resulted in the colonization of a wider area than had been possible under previous systems of cultivation... The use of milk made much larger herds economical, making use of exhausted and otherwise marginal land and encouraging the development of the pastoral sector with transhumance or even nomadism (Sherratt 1981: 159-160; see also Sherratt 1998).

Fig. 22. Traditional wealth. Cattle among the Sukuma, Tanzania. Photo: Terje Oestigaard.

However, a major challenge to studying early Indo-European pastoralists is the lack of historical sources on groups living in the northern regions with harsh winter climates. In contrast, there is an abundance of studies of pastoralists in the south, particularly in Africa and the Nile Basin. Still, from a comparative perspective, African studies offer valuable parallels, as cattle share fundamental biological traits despite their regional adaptations to different ecological environments (Fig. 22).

First, pastoral societies are fundamentally dependent on their environment and the availability of good-quality pastures, as the survival of their livestock depends on it. Cross-culturally, the productivity of pastures depends on seasonal rain or annual flooding, placing pastoral communities in an intimate relationship with their changing environments. As a result, rainmaking rituals often occupy a central place in their religion and cosmology. Without timely and adequate rainfall, sufficient fodder cannot be produced, putting the entire community at risk (Seligman 1932, 1934; see also Oestigaard 2018).

Second, pastoralists are at a significant advantage over agriculturalists, as their cattle can be moved to areas where pasture is more abundant. In contrast, farmers are tied to the land they have inherited or acquired, and if the rain fails, their options are limited mainly to economic diversification and adaptation. Pastoralism, as a distinct adaptative strategy, inherently implies mobility, as the availability of fodder varies across seasons and geographic locations (Jacobs 1996; Johnson 1986; Oestigaard 2014).

Third, pastoral societies are often violent, as the survival of the herd constitutes the highest priority for any pastoral community. If the cattle die, people will die. During periods of ecological stress when water and fodder are scarce, multiple pastoral groups are affected at once. This frequently results in intense and sometimes violent competition over access to vital grazing areas. In such times of stress, the search for adequate resources becomes a matter of life and death for all pastoral groups. These dynamics are deeply embedded in religious and cosmological systems of pastoralists (Lienhardt 1961; cf. Lincoln 1976).

Fourth, pastoral societies are also prone to violence because of the economic value of their herds. In preindustrial societies, cattle raiding was one of the fastest ways of acquiring or losing great wealth. As a result, protecting herds becomes a key concern, shaping social roles and structure. Like the armed American cowboys of the 19th century, pastoral herders often carry weapons, leading to the development of

violent, hierarchical social structures. Moreover, the high value of cattle influences social organisation in other ways too, such as the use of cattle as bride wealth (e.g. Roscoe 1911).

Fifth, cattle are equated with wealth. The Maasai in Kenya and Tanzania, for instance, were once called the 'lords of the plains' because of their large herds (Lonsdale 2008). Among other groups there is a saying that 'Our great bank is cattle' (Bjerk 2006). The wealth of pastoralists was real and was easily exchanged for other commodities. A healthy cow giving birth to a calf each year implied a doubling of the original investment – an interest rate no bank can match (Kjerland 1995). This wealth and mobility was, however, heavily dependent on the availability of rich pastures and strong protective structures (Fig. 23).

Sixth, pastoral societies effectively carry their food supply with them. Cattle provide daily milk, which has historically formed the basis for a diet centred on milk, blood and meat. Milk requires neither storage nor transport, as herders are always close to their herd. Livestock was seldom slaughtered, as this would diminish the herd and, by extension, the community's wealth. However, when animals were sacrificed and consumed, it provided a significant nutritional supplement. Such sacrifices were usually reserved for major festivals and must be seen in relation to the broader religious practices, particularly those surrounding rainmaking rituals (e.g. Simonse 1992).

Fig. 23. Cattle and calves among the Sukuma in Tanzania. Photo: Terje Oestigaard.

Pastoralism in South Sudan

The Sudd, located in present-day South Sudan, is the world's largest swamp, spanning approximately 1,300 km – roughly the distance between London and Vienna (Green & El-Moghraby 2009: 194). The extent of the swamp varies significantly depending on seasonal flooding and the rainy season. Writing on the Sudd, Douglas Johnson noted:

> The hydrology of the region is thus crucial to human settlement. If the river has a sustained rise in the wet season, then many riverine dry-season pastures may remain flooded and unusable for most or all of the year. A prolonged high level of flooding over several years can also make settlement sites near the river untenable or inaccessible, forcing people to move... It is not pastoralism alone that keeps people moving. It is mainly the environment which has made movement and resettlement a constant fact of life. The historical pattern of flooding, which produces an ever-changing mosaic of water-logged and dry areas, continually draws people into and out of the eastern plains (Johnson 1986: 134, 138).

The variability of floods and rainfall has historically been the key determining factor of mobility and migration in the region, as it directly affects the availability of pasture, and, consequently, the survival of cattle. This area is home to some of the world's most renowned pastoralist groups: the Nuer and the Dinka, who, with the neighbouring Shilluk, combine pastoralism with sedentary agriculture (Fig. 24). These groups are collectively referred to as Nilotic peoples. Historically, other pastoralist groups such as the Bari, lived in northern Uganda (Seligman & Seligman 1928).

In 1940, the British anthropologist E.E. Evans-Pritchard published his seminal book *The Nuer. A description of the modes of livelihood and political institutions of a Nilotic people* (Evans-Pritchard 1969[1940]). Among the Nuer, cattle were central to all aspects of life, to the extent that people with few or no cattle were regarded with contempt. Although the Nuer did cultivate small quantities of millet and maize, their identity as a pastoralist society remained dominant. Social relationships and even religious beliefs and structures were expressed in terms of cattle (Evans-Pritchard 1956, 1969). Evans-Pritchard notes:

Fig. 24. Dinka cattle in Western Bahr el Ghazzi, Sudan. Source: Wikimedia commons. Photo: Michael Walsh. License: CC BY 3.0.

> It has been remarked that the Nuer might be called parasites of the cow, but it might be said with equal force that the cow is the parasite of the Nuer, whose lives are spent in ensuring its welfare… In truth the relationship is symbiotic: cattle and men sustain life by their reciprocal services to one another. In this intimate symbiotic relationship men and beast form a single community of the closest kind (Evans-Pritchard 1969: 36).

Though they lived in a marshland and along the banks of the world's longest river:

> Scarcity of rain is probably more serious than low river water, but both may inconvenience the Nuer to the point of famine, because sufficient water may not be held up in the clay beds to enable the grasses to recover from firing; inland watercourses may quickly dry up and compel movement to lakes and rivers earlier than is desirable; and there may be a shortage of the marsh pasturage which is usually the mainstay of the cattle at the end of the dry season. Insufficient rain may also destroy the millet (Evans-Pritchard 1969: 55).

However, along the Nile as elsewhere, the annual rains represented a double-edged sword: too much or too little could threaten the survival of livestock, and by extension, human livelihoods:

> The early rains are the season of fatness, for then the grasses germinate, or renew their growth after the long drought… As the rains advance, grazing becomes more difficult, the ground being flooded and the vegetation rank, and in years of high water may be a serious problem. The cattle must rely on the short grasses that prevail on village ridges: a further reason that compels Nuer to occupy these sites in rain… variation of water supplies and vegetation thus forces Nuer to move and determines the direction of their movements (Evans-Pritchard 1969: 59, 61).

In other words, the variability of rainfall was the main driver of movement and migration, as it directly affected vegetation and, consequently, the availability of fodder. In much of Africa, sunlight was abundant and the growth of grasses and vegetation depended on an optimal balance between water – through rain or flood – and solar energy. Excessive sun could be catastrophic and prolonged periods of intense sunshine were often interpreted as the work of a malevolent rainmaker. 'Willing the sun' was considered a grievous offence. A rainmaker accused of withholding the rain and allowing the scorching sun to prevail could be executed (Seligman 1932: 295). The rationale for such an act was pragmatic: 'He is killing us, so why should we not kill him?' (Simonse 1992: 199).

Pastoralism and transhumance in Scandinavia

Shifting focus from South Sudan to Scandinavia, one encounters a very different ecological context that required particular forms of adaptation. In this region, full nomadism was largely unfeasible due to the harsh winter conditions. Pastoralists had to settle in one place during the winter months, as cattle could not move through the deep snow in mountainous regions and were historically kept indoors. This specific ecology gave rise to a unique seasonality and festive seasons. In addition to the Christian celebrations – which often blended both Christian and pre-Christian elements – two annual milestones held particular significance in the transhumance cycle and broader adaptive strategies of

Scandinavian farming communities: the spring release of animals from their stalls and their return back to the farm in autumn. The final winter months were defined by 'starvation feeding', when fodder reserves were nearly depleted and the arrival of spring grazing was a time of celebration. While grazing resources near the farms were limited, the mountain pastures offered abundant fodder (Fig. 25). These upland areas, along with forests, woodlands and lower mountain areas also provided essential winter supplies of hay and leafy fodder, collected during the summer months (Solheim 1952: 1-4).

The return of animals in autumn after an extended grazing periods in the mountains marked a significant moment in Scandinavian farming communities. It was one of the most important annual festivities of the year, as the safe return of healthy livestock ensured survival through the difficult winter months.

Fig. 25. 'En Aften ved Sæteren' by Knud Bergslien – a milk maiden at the mountain pastures a summer evening. From *Norske Folkelivsbilder* (1858). Public domain.

In many villages, the milk-maiden, who looked after the animals during the summer, was honoured upon her return. Sometimes she was treated almost as royalty and seated in the farm's high seat, a position of honour. She also received gifts, and the family gathered to share food prepared from the autumn harvest (Solheim 1952: 604-614).

While in many cultures and societies shepherds also assumed the role of warriors, in Scandinavian ethnography they were primarily viewed as protectors. This role extended beyond protecting livestock from visible dangers such as wild animals to include defence against invisible forces and malevolent spirits. The highlands and mountainous regions were believed to be inhabited by numerous wights and other supernatural beings. Shepherds used symbolic tools, such as iron and fire to protect their herd from these visible and invisible creatures (Solheim 1952). The ecological and economic adaptation in prehistoric pastoral and farming societies, whether in Scandinavia or on the steppes, shows that the most important and dramatic changes in natural environments were related to seasonal and weather-induced changes. Not only surviving, but also developing unique adaptation and risk-mitigation strategies through the long, dark and cold winter period reveals an intimate relationship between ecology and cosmology. These successful ecological human-nature relations created long Indo-European trajectories in time and space. Following Fernand Braudel:

> History exists at different levels, I would even go so far as to say three levels but that would be only in a manner of speaking, and simplifying things too much. There are ten, a hundred levels to be examined, ten, a hundred time spans. On the surface, the history of events works itself out in the short term: it is a sort of microhistory. Halfway down, a history of conjunctures follows a broader, slower rhythm ... And over and above the 'recitative' of the conjuncture, structural history, or the history of the *longue durée*, inquires into whole centuries at a time (Braudel 1980: 74).

The slow-changing and long continuities in history were often related to natural forces, successful adaptation and human modes of production. In other words, it is precisely in agrarian or pastoral ecologies and cosmologies that one can trace Indo-European continuities and long historic trajectories, as some strategies proved more effective than others in extreme environments. While farmers have always been concerned with cultivating and activating growth forces and securing

continuity from one growth season to another, in the cold north animals also had to adapt to the ecological realities. In warm climates, pastoralists can follow the rain and seek out pastures with abundant fodder, but in the cold north cattle in hilly or mountainous regions will inevitably be sedentary for large parts of the year because of harsh winters. Thus, Indo-European adaptation strategies showed ecological and cosmological worldviews that emphasised seasonal con-tinuity as well as ritual practices and beliefs that reflected a holistic view of harvests and animals (Oestigaard 2022b).

Pastoralism on the steppes

Shifting focus from comparative ecologies to the Eurasian steppes and the ecology of the Volga region (Fig. 26), studies of nomadism in Kazakhstan – where several rivers flow into the Caspian Sea – offer important perspectives. In *Nomads and the outside world*, a book about pastoralism and nomadism, A.M. Khazanov writes (1984: 73):

> In Kazakhstan in the nineteenth century jute [plat, bast fibre] was a serious problem and in some years caused between half and three quarter of the overall number of livestock to perish, large scale losses occurred every 6-11 years and local ones almost annually.

Khazanov points to a key practical challenge: preparing for and surviving the winter. Providing sufficient water and fodder for cattle during the harshest winter months was central to the economic structures of nomadic life. The time spent in camps or on migration, including the frequency and length of journeys, depended on the availability of these resources. Another determining factor was the availability of labour to gather the necessary amount of fodder for winter. If the stores of hay could not sustain the animals through the winter, nomads were forced to migrate in search of pasture, however limited it might be (Khazanov 1984: 50, 72). In other words, when there were too few people to secure winter fodder, movement became necessary even in winter.

On the steppe, seasonal migration followed a north-south axis, with summer grazing in the north and a return to the south for winter. In the Black Sea region, harsh winters were mitigated by the presence of Phragmite marshes, where reed beds could grow up to 25 feet tall.

Fig. 26. Volga River basin. Source: Wikimedia commons by Pline, CC BY 4.0.

These reeds not only stood above the ice and snow, providing fodder throughout the winter, but also provided shelter from the cold winds for both humans and animals (Anthony 2016: 24). Anthony describes the dangers and difficulties pastoralists in the north faced:

> …steppe pastoral subsistence was inherently prone to famine when winter blizzards or spring storms froze or starved entire herds… high annual variation in the severity of the steppe winters and in the productivity of wild steppe pastures meant that steppe herds regularly suffered steep declines, so pastoralists could never depend on livestock alone and therefore

> supplemented their diet with agricultural foods, even during periods when they were nomadic… In northern steppe pastoralism, the most critical resource was winter fodder/ grazing and protection from winter ice and snow (Anthony 2016: 21, 24).

Khazanov and Anthony both highlight key challenges and adaptive strategies for surviving winter. Water, fodder and shelter were the primary concerns. Riverbanks and floodplains often provided access to grass and shelter, making them optimal sites during both summer and winter. These areas often included marshes, especially when frozen or after a fertilising flood period. As Anthony writes with regards to Sintashta in *A Bronze Age Landscape in the Russian Steppes. The Samara Valley Project*:

> The first cultures to settle in permanent locations near marshes were the Sintashta culture, east of the Urals, and the Mnogovalikovaya culture (now also called the Babino culture) in Ukraine, both east and west of the middle Volga steppes, beginning around 2100 to 2000 BC. All Sintashta settlements were built on the first terrace of a marshy, meandering stream close to winter grazing, rather than on a more easily defended elevation, despite the clear concern with defence implied by Sintashta earth-and-palisade fortification walls. The settling-down trend affected the middle Volga steppes somewhat later, beginning around 1900 BC, but the preferred location for settlements was the same: low terraces beside the wet floodplain, preferably beside a large marsh composed of high, dense stands of Phragmites and Typha reeds (Anthony 2016: 24).

As previously mentioned, Sintashta culture played a key role in the process of Indo-Europeanisation, as it was located close to the Ural Mountains in central Russia. While Sintashta culture is mainly known for its fortified settlements, bronze metallurgy, horse domestication and the invention of the two-wheeled spoked chariot, the earliest settlements were located in marshlands and along waterways. In the Samara region, early pastoral Indo-European communities settled near rivers, swamps and other water sources:

> The Sharlyk swamp is situated in the middle Volga region… it is located in the basin of the Samara River (a left tributary of

> the Volga River) in the center of the Samara region. It is near the village of Krasnosamarskoe… The Samara River, which is about 575 km in length, is one of the longest rivers in Eastern Europe. Connecting the Volga and Ural regions of Russia, this river is also considered to be the dividing line (or ecotone) between the steppe and the forest-steppe (Popova 2016: 92).

Although situated in a very different ecological context than the Sudd in South Sudan, swamps and rivers were equally vital to pastoral groups in the Eurasian steppes. Importantly, Anthony (2016) notes that, historically, the seasonal migration in this region typically followed a north-south axis, with summer grazing in the north and herds returning south in winter.

Winter droughts in Eurasia

The Eurasian steppe constitutes the world's largest contiguous rangeland (Kerven et al. 2021). For Mongolian pastoralists, climatic variability and extreme weather events posed serious threats to both livestock and social stability. However, the most severe threat was snowfall, which caused higher mortality than droughts during the rainy season (Begzsuren et al. 2004: 793):

> The pastoral systems… may be more vulnerable to winter livestock mortality due [to] the limited mobility during the winter. Winter forage sites are selected areas and restricted in area. Mobility is limited due to the harsh winter conditions under which long-distance movements of livestock and pastoralists are not possible… During droughts, pastoralists in the regions are more able to move their livestock to regions with higher forage availability and therefore reduce the risk associated with droughts.

From a long-term historical perspective, Michael D. Frachetti argues that 'pastoralist mobility was likely similar to what we see in the ethnographic record: seasonal mobility patterns of variable distance that brought populations between known ecological zones as they seasonally came into various stages of productivity' (Frachetti 2015: 9). He adds:

> Ethnographically documented patterns of mobility recorded about eighteenth and nineteenth century Kazakh nomads in the open steppe zones depict longitudinal seasonal migrations of various distances ranging from 10 to 15 km up to hundreds of kilometers, mainly oriented North/South…Thus, both archaeology and ethnography reveal regular, seasonal oscillations rather than cumulative and sequential events of group displacement. Interestingly, little evidence exists among ancient and historical pastoralists of east to west mobility. In other words, the mobility patterns that operate at the scale of populations actually exploiting their Eurasian grassland environments were fairly regional or local, and brought populations back and forth repeatedly and only minimally shifted homeland territories (Frachetti 2015: 9).

This pattern of primarily north-south migration is supported by other studies (e.g. Kerven et al. 2021: 6). However, such a migratory pattern, typical of pastoral economies, cannot account for the extensive west-east / east-west movements that characterised the Indo-European expansion. What David Anthony and others essentially describe is migration routes that follow the north-south orientation of rivers, along which herds moved without crossing. East-west movements, in contrast, were impeded by the course of rivers that bisected the landscape. Based on topography and hydrology, north-south migration appears to have been the most viable seasonal strategy. Nevertheless, the Indo-European steppe cultures, from the Yamnaya period onwards, also strongly expanded in other directions, especially along the east-west axis.

This implies that the early Indo-Europeans overcame the natural barriers created by the north-south flowing rivers. The key to understanding how they did this probably lies in the specific location of their settlements. The banks of the Volga River represent one such strategically significant location. As the largest river in Europe, the Volga flows mainly eastwards for much of its course, and freezes in winter. Further west, in a region central to the early Indo-European expansion – from the Yamnaya westwards towards Central Europe, and later back eastward, there is another important river. In the development of the Fatyanovo culture, we find the river Pripyat with its vast wetland area. The Pripyat, a major tributary of the Dnieper, also flows eastwards from present-day Poland to Ukraine. This region is also home to the Middle Dnieper culture, which played a crucial role in the merging of the Core

Indo-Europeans and the European Neolithic farmers, facilitating the emergence of the Fatyanovo-Balanovo culture and, eventually, via Sintashta, the Indo-European expansion into the Indo-Iranian area. The question, then, is whether rivers such as the Volga and Pripyat should be seen not as barriers to migration but rather as corridors – natural highways – that enabled movement along the latitudes.

Before proceeding with the analysis and the cultural-historical interpretation of pastoralist migrations involving large herds of cattle, it is necessary to consider the hydrology of Eurasian river systems and the ecology of their basins.

7. The Pripyat, the Volga and Eurasian Rivers

Rivers and the formation of Core Indo-European culture

Given that the lives and well-being of livestock are central to pastoral societies, the surrounding ecology inevitably shapes patterns of behaviour, particularly migration routes and practices. The same environment and water-world present both opportunities and constraints, depending on a group's adaptative capacity and technologies available at that time. These practices are always embedded in broader cultural and cosmological frameworks. With this theoretical and ecological backdrop, we can now turn to the waterscapes of the Eurasian steppes and their adjacent regions (Fig. 27).

The Volga River and regions surrounding it played a central role in the formative stage of the Yamnaya culture and appear to have remained important to subsequent Indo-European migration and cultural diffusion. The Yamnaya archaeological complex emerged around 3300 BC on the Pontic steppe – north of the Black and Caspian Seas – and expanded both eastward and westward. The Yamnaya culture was formed through the mixing of earlier populations, primarily a so-called Caucasus–Lower Volga group, itself a blend of southern Caucasus populations and northern groups located at the Volga bend, where the river shifts from a west-east to a north-south course.

The so-called Dnieper cline was formed when this Volga group migrated westward, mixing with Ukrainian Neolithic hunter-gatherers along the Dnieper and Don rivers, giving rise to Serednii Stih groups, from which the Yamnaya ultimately emerged. The Caucasus-Lower Volga group is estimated to have contributed around four-fifths of Yamnaya ancestry. Significantly, this group also played a key role in the introduction of proto-Indo-European language into Anatolia – corresponding with the early divergence of the Anatolian branch of Indo-European (e.g. Hittite), which probably occurred before the full development of Yamnaya culture on the steppe (Lazaridis et al. 2025).

The Volga River occupies a central position in the region where the Yamnaya culture first emerged through the fusion of earlier groups. It was also from here that the decisive early Core Indo-European migrations originated.

Fig. 27. Boat on the Volga at Lake Sterzh. Source: Wikimedia commons by Евгений Петрович Вишняков, 1891. Public domain.

The Volga also appears to have been significant for continued Indo-European migrations and cultural spread. With its central position and east-west orientation across the steppe, it has long been a dominant geographical feature, shaping movement and settlement at key historical junctures.

The second river of interest in this context is the Pripyat, a tributary of the Dnieper, with its basin situated in what is now north-eastern Ukraine and southern Belarus. The town of Pripyat – named after the river and known for its abandonment following the Chernobyl disaster in 1986 – remains an eerie Soviet-era time capsule nearly 40 years on. In what follows, we will primarily focus on the Volga River, its ecological conditions and its role in the formation and initial spread of the Core Indo-European culture – though we begin with the Pripyat and its connection to the Dnieper River into which it flows.

Pripyat – the Middle Dnieper culture and the reflux to the east

The area associated with the Middle Dnieper culture served as an important corridor between east and west, not only in historic times but also during early migrations. The Pripyat River – a west-east flowing tributary of the north-south-oriented Dnieper – was crucial for interactions between the western Yamnaya culture, early European farmers and the emerging Fatyanovo culture to the north-east. Through the Dnieper River, this region linked the southern steppe with the northern forest-steppe, while the Pripyat opened an effective east-west contact route.

Originating in the Volhynian Upland in western Ukraine, the Pripyat River flows east through Ukraine, Belarus and back into Ukraine again, eventually joining the Dnieper. Over its 775-km course, it crosses vast sandy wetlands, swamps, bogs and floodplains, whose shores are likely to have provided excellent pastureland. In its upper course, the river's floodplain spans 2-4 km, widening to 10-15 km downstream. Some years, these floodplains remain inundated for several months. The river is up to 70 m wide in its upper reaches, widening to more than 200 m near its confluence with the Dnieper. The river has a very calm course, especially in its lower reaches.

The Pripyat River drains the vast Pripyat Marshes – also known as the Pinsk Marshes – one of the largest wetland areas in Europe. These marshes span much of southern Belarus and north-western Ukraine, extending along the river's course. The surrounding landscape is characterised by a dense network of rivers, streams and wetlands across a vast lowland area stretching 480 km from west to east and 225 km from north to south. The marshes change dramatically with the seasons: in spring, snowmelt causes widespread flooding, and in autumn, heavy rains produce similar effects. Historically, the marshes were practically impassable for much of the year, posing significant challenges for transportation. This was evident during various military campaigns, including Napoleon's 1812 invasion, and, even more so, during WWI battles between Austrian-German and Russian forces.

The Dnieper River and its tributary Pripyat are likely to have played a central role in the east-west migration of groups carrying the Core Indo-European language into Europe, as well as the later reflux to the north-east – bringing a mix of Core Indo-European and early European farming ancestry into the Fatyanovo culture.

As discussed in previous chapters, the Fatyanovo culture played a pivotal role in transferring genetic and cultural elements eastwards, eventually giving rise to the easternmost expression of the Corded Ware complex: the Abashevo culture. Later, the 'second cousins' of the Corded Ware populations emerged: the Sintashta culture. Located in the steppes on the border between southern Russia and Kazakhstan, this region was the point of departure for the southward expansion of the Indo-Iranian branch of the Core Indo-European lineage:

> The area of the Fatyanovo Culture stretches from the upper reaches of the Dnepr and Desna Rivers and Lake Peipus to the Mari El and Chuvash Republics on the Middle-Volga, whereas Balanovo extends all the way to the Vyatka–Kama interfluve.... The distribution area is located in the zone of deciduous or mixed forests, with sites and finds following the major river valleys and watersheds, even if individual discoveries have been made further away in the surrounding territories (Nordqvist & Heyd 2020: 68).

Individuals from the Fatyanovo culture are genetically similar to other Corded Ware groups, carrying a mix of steppe and early European farmer ancestry and originating from a rapid north-east migration along the Pripyat and Dnieper rivers. Their homeland lies in present-day Ukraine and eastern Romania, where these ancestries coexisted from around 3000 BC. Additional admixture with hunter-gatherer populations in the northern forest belt further shaped the Fatyanovo, giving them a distinct cultural and genetic profile compared to the Yamnaya, despite their common steppe heritage (Saag et al. 2021).

In this sense, the Middle Dnieper culture and the western part of the Fatyanovo culture can be seen as a plausible point of origin for the Balto-Slavic branch of the Core Indo-European languages and culture, as previously discussed. The movement of people and animals along the river courses are likely to have played a decisive role in shaping these shared traits, while also opening up contact routes and facilitating continuous connections over time.

The Volga River

The Volga is Europe's longest river. It originates in the Valdai hills northwest of Moscow and flows roughly 3,530 km to the Caspian Sea.

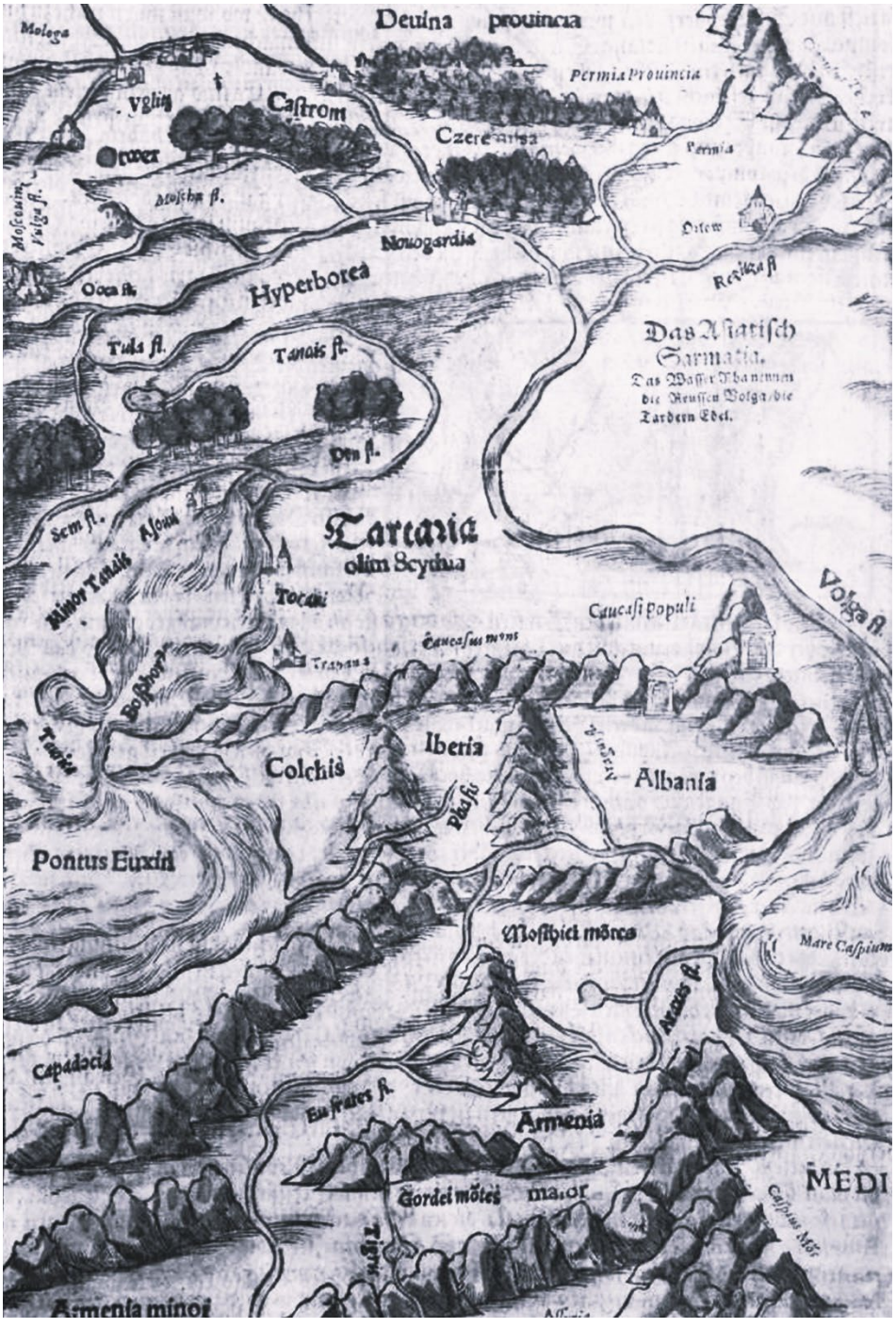

Fig. 28. Map of Volga River (1600) by Sebastian Münster. Public domain.

Along its course, the river receives water from around 200 tributaries and traverses mostly flat landscape, descending from 228 m above sea level to 28 m below sea level. The Volga is divided into three sections: the Upper Volga (from the source to the confluence with the Oka River), the Middle Volga (from the Oka to the Kama confluence) and the Lower Volga (from the Kama to the Caspian Sea). From its source near Moscow to the Kama confluence, the Volga flows predominantly west to east; from this point, it changes course and flows mainly south toward the Caspian Sea (Fig. 28).

The Volga has been perceived and described in many different ways throughout history, and historical accounts offer a glimpse of this powerful river and the challenges it posed to sailors. In modern history, the Volga has often been difficult to navigate, with journeys taking considerable time. For example, in 1794 it was estimated that the journey from Kazan to Rybinsk – a distance of about 970 km on modern roads – took about 53 days. In the 1830s, travelling from Astrakhan on the Caspian Sea to Nizhnii Novgorod – around 1,400 km by road today – could take two to three months (Hartley 2021: 175).

For much of the year, the Volga is frozen. It typically opens for navigation in late March or early April and freezes in late October or early November. 'Of all the navigable rivers of Europe, there is probably none so uncertain and difficult of navigation as the Volga', Laurence Oliphant complained during his 1852 journey. 'The navigation of the river generally closes about the end of October; and during the winter the whole river as far as the Caspian is frozen over' (Oliphant 1854: 35, 37). He continued: 'In winter, of course, trade is at a stand-still, communication being alike impracticable by sea or land, except in sledges. The passage across the gulf to Azov upon the ice is then quite feasible' (Oliphant 1854: 127). During particularly harsh winters, the river freezes earlier or remains frozen for longer, and spring often brings massive floods, with water levels rising by as much as 15 m. In the stretch from Nizhny Novgorod to Vasilsursk – 500-600 km east of Moscow – 'The river itself varies from one to two miles in breadth, and occasionally the stream is very rapid' (Oliphant 1854: 38).

The Volga flows eastward from its inland source near Moscow and, historically, was not connected to the Baltic Sea (see Kraikovsky & Lajus 2010). St. Petersburg was founded by the Tsar Peter the Great in 1703 and served as the capital of the Russian Empire from 1712 to 1918. 'Before the construction of the railway line that connected the two capitals of the empire in 1851, most loads – food, fuel and construction materials –

arrived in St Petersburg by water. The first canal system to link the new capital of the empire with its heartland provinces was built from 1703–9' (Loskutova 2020: 256). This early canal connected St. Petersburg to Lake Ladoga. The first navigable link between the Volga and the Baltic opened in 1731, followed by two additional routes that were completed in 1810 and 1811 (Britannica 2025).

Moving closer to the source of the Volga and the current capital, Moscow, one finds the Moskva River, which flows into the Oka, one of the tributaries of the Volga. The Moskva River has a width ranging from 100 m to 250 m (Razumov & Tyutyunova 2001).

Hydrology

The Volga River Basin, with a catchment area of approximately 1,360,000 km^2, is the largest in Europe. The main sources of runoff in the basin are snowmelt and precipitation, with around 60% of the river's water originating from snowmelt and the remaining 40% from rain.

> The largest amount of water in the Volga is observed in spring, during flooding, and in fall, during the period of heavy precipitation. In winter and summer, the water level in the river decreases significantly. The Volga freezes around November, only the upper and lower reaches, the Lower Volga freezes in December. It is released from ice fetters first in the lower reaches, approximately in early March, and in the upper reaches only in April (Safarov et al. 2024: 4).

The Caspian Sea is the world's largest continental water body, with a surface area of nearly 400,000 km^2 and a total volume of approximately 78,000 billion m^3 (or 78,000 km^3). The Volga River contributes around 80% of the total water inflow to the Caspian, averaging 237 billion m^3 annually, though actual annual discharge can vary significantly (e.g. Dumont 1998, Tudryn et al. 2016, Samant & Prange 2023). This highlights the enormous hydrological significance of the Volga.

In comparison, the Nile – often seen as the longest river in the world – had an estimated annual average flow of 84 billion m^3 at Aswan in the second half of the 20th century (Waterbury 1979, 1983), meaning the Volga, on average, discharges nearly three times as much water. However, as noted by Georgiadi & Borodin (2022), between the 19th and 21st centuries there have been extreme low-flow events in the Volga and

other major rivers on the East European Plain, such as the Don, Dnieper, Western Dvina, and Northern Dvina, reflecting the region's significant hydrological variability.

From a historical and, especially, prehistoric perspective, estimates and measurements of hydrological data are inevitably uncertain. Today, the Volga River is heavily dammed. Over the past 40 years, natural river flows in Russia have undergone a 30% increase in artificial regulation (Kalugin 2022). The Volga itself hosts eight major hydroelectric power stations, with an additional three on its main tributary, the Kama. The first of these was completed in 1937. Many of the dams along the Volga are multipurpose, serving not only for electricity generation, but also for irrigation and navigation.

In the Lower Volga region, an area of more than 7,000 km² is under irrigation (Schletterer 2019: 513). While hydroelectric dams release stored water through turbines – thus generating electricity without significantly reducing total downstream water volume over time – irrigation systems permanently divert water for use on agricultural fields, thereby reducing the volume that continues downstream. Furthermore, interbasin transfer projects, such as the connection between the Volga and Don rivers, significantly affect regional hydrological balances (Figs. 29a & 29b).

Although dams can significantly alter river flow and irrigation systems reduce the overall discharge reaching the Volga Delta and Caspian Sea, contemporary hydrological data remain useful in this analysis. Despite modern interventions, the current hydrological regime still offers valuable insight into the broader water dynamics of the Volga River system and can serve as a proxy for understanding its conditions prior to industrialization and the era of globalization.

> It should also be kept in mind that the area along the banks of the Volga River is characterized by a high degree of industrial and agricultural development. However, among the factors affecting the hydrological regime of the Volga River, the advantage of climatic factors is undoubted. The average runoff volumes for the period of natural (1881–1957) and regulated (1961–2017) regimes according to the data of the Volgograd hydrological station are very close – 256 km3/year and 249 km3/year, respectively (Safarov et al. 2024: 2).

Fig. 29a. Stalin and Molotov with Nikolai Yezhov along the Volga-Don Canal in 1937. After the great purge, Yezhov was removed from the picture, fig. 29b. Public domain.

In other words, in the past – before the construction of dams and the introduction of large-scale irrigation – run-off into the Caspian Sea would have been higher, assuming that flow and precipitation patterns were comparable to current levels. Contemporary flow data can therefore be regarded as minimum estimates when discussing historical hydrological conditions, provided that climatic and ecological parameters have remained relatively constant (see below).

The Volga Delta

With a surface area of 20,000 km^2, the Volga Delta is the largest delta in Europe and the tenth largest in the world. The length is also staggering: 'The onshore part of the Volga delta occupies about 20,000 km2, with a distance from apex to coast of 105-120 km and a highly indented coastline of about 800 km shoreline length at a delta width of 200 km.... At the very coastline over 800 outlets are found, up to 6 per km, with an average depth of 1-3 m. There are a few larger outlets, but there is no single main channel' (Kroonenberg et al. 1997: 192, 194). According to data from the Volgograd hydrological station, the average annual runoff of the Volga River for the period 1881–2016 was 253 billion m^3 per year (km^3/year). The highest recorded flood occurred in 1926 (389 km^3/year), while the lowest took place in 1975 (160 km^3/year) (Safarov et al. 2024:4).

Average temperatures in the delta region are around 26°C in July and -8°C in January, though temperatures can rise to 45°C in summer and drop to -40°C in winter. The shallow areas of the north Caspian Sea freeze in the winter, with 120-140 days of ice cover and ice reaching a thickness of 20-30 cm. Average discharge in the period 1880-1980 was 241 billion m^3, with approximately 60% occurring during the snowmelt and flood period from April to June (Richards et al. 2014:1227). Despite climate change and global warming, winters in the delta region remain cold. Between 2000 and 2019, the mean duration of ice events at the top of the Volga Delta was 84 days, including 64 days with freezing conditions (Migunov et al. 2023:1040).

In the article 'Reconstructions of deltaic environments from Holocene palynological records in the Volga delta, northern Caspian Sea', Richards et al. write:

> The period 8900–3770 cal. BP was characterized regionally by extensive steppe vegetation, with forest present at times with

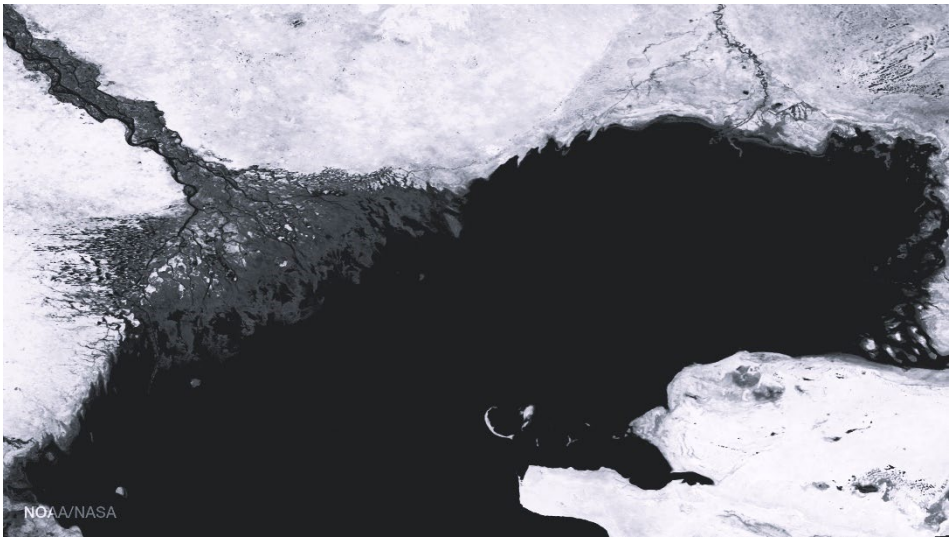

Fig. 30. The Volga Delta and the Caspian Sea. Source: NOAA (National Oceanic and Atmospheric Administration, US). Public domain.

> warmer, more humid climates, and with halophytic and xerophytic vegetation present at times of drought. The period 3770–2080 cal. BP was a time of active delta deposition, with forest or woodland close to the delta, indicating relatively warm and humid climates and variable Caspian Sea levels… evidence from the central and southern Caspian Sea regions also suggests that early to mid-Holocene Caspian Sea levels were mainly high, *with highest levels being reached prior to c. 4000 cal. BP* (Richards et al. 2014: 1226, 1244, our emphasis).

According to this study, the main period in question, 3000-2000 BC, was a time of abundant water, as evidenced by active delta deposition in the Volga Delta along the Caspian Sea and the high sea levels prior to 4000 cal. BP.

A journey from the Baltic Sea through Moscow to the Caspian Sea provides an impression of the hydrology of Europe's longest river. Although the Volga stretches over 3,500 km, the total elevation drop is only about 250 m. This makes the river voluminous, slow flowing and wide (Fig. 30). In contrast, rivers descending from mountainous regions are often torrential and powerful, but rarely wide. Flat plains, by comparison, produce broad, relatively shallow rivers.

If the width of a tributary close to the source reaches up to 250 m, closer to the delta the width is staggering. 'The Volga continues flowing

south-east below Volgograd reservoir, and the major side-arm Akhtuba begins…. The river then flows another 350 km, its width varying from 15 to 45 km, to the delta' (Mineeva et al. 2022: 35). As indicated, there are often uncertainties with regards to prehistoric hydrological data, but even if the Volga was smaller in the past – with an estimated width of 100 m close to the source and 1,400 m closer to the delta – these still represent vast expanses of open water, especially challenging to cross with cattle. In practice, crossing the river during summer would have been nearly impossible, while during winter, when the waters were frozen, would have made passage easier. With this hydrological context and its implications for cattle ecology in mind, one can begin to explore prehistoric migration routes and broader cultural-historical processes.

8. A model of Indo-European migrations and pastoral adaptations in cold climates

Muslim travellers on the steppes and along the Volga

Before presenting a model that combines west-east / east-west migrations with north-south / south-north migrations, it is useful to consider other historical sources that describe the ecological challenges and opportunities of the Eurasian steppes in winter. These accounts highlight historic encounters with ice and cold, and how the winter season created both obstacles and opportunities.

The Muslim ambassador and traveller Ibn Fadlan is best known for his detailed description of a Viking cremation along the Volga in 922 AD. However, his account also offers valuable insights into the reality of travel across the steppe and along major rivers, particularly in winter. Like other Muslim travellers, Ibn Fadlan's first-hand accounts of life along the banks of these great rivers during winter provide important information.

While he complains of the cold, Ibn Fadlan says: 'The Jayhūn River froze for its entire length and the ice was seventeen spans thick. Horses, mules, donkeys and carts slid over the ice as if on roads, and the ice was solid and did not crack. The river remained like this for three months' (Ibn Fadlan, p. 8).

When the river was not frozen, and if it was not too wide and the current not too strong, 'as to the horses and the camels, they call them with loud cries and they swam across the river.' However, this was a dangerous undertaking, 'I saw a leather boat overturned in midstream and those who were in it drowned. Many of our men were carried away and a certain number of horses and camels were drowned' (Ibn Fadlan, p. 22-23).

Referring to the Lower Volga in the delta region, Abū Hāmid, another Arab traveller writing between 1130 and 1155, comments: 'I sat sail of the Caspian Sea and reached a mighty river like a sea, many times larger than the Tigris, and from it flow other large rivers' (Abū Hāmid, p. 63). He goes on to describe the properties and function of frozen rivers, 'The river freezes until it is like land, and horses and animal carts can travel along it. They even fight on the ice. I crossed the whole river

when it was frozen and it was more than 1,840 of my paces wide, excluding the tributaries' (Abū Hāmid, p. 65).

A pace was usually measured as the length of a walking step, but sometimes it was two walking steps. If a step is approximately 0.75 m, the river described by Abū Hāmid was 1,400 m wide. He writes that the cold is so intense that 'wood splits', adding that this season of great cold is also seen as an opportunity, when 'the king sets out on raids against the infidel and captures his women, his sons, his daughters and his horses' (Abū Hāmid, p. 67).

In short, during summer one could cross open waters, though it remained a dangerous undertaking as horses and camels often drowned. Winter, when lakes and rivers were frozen, was the safest time to cross these large bodies of water. This insight, along with the previously discussed empirical evidence about cattle and climate, can form the basis for a model of migration from a water-systems perspective.

Migration and pastoralism

There is no generally accepted definition of the concept of migration. In its simplest understanding, it refers to the movement of people from one place to another. However, such a definition is too superficial as an analytical tool, as it does not distinguish between individuals and larger groups. Nor does it differentiate between short travel to nearby areas and journeys across thousands of kilometres, nor whether they are seasonal or permanent migrations. Another aspect that is overlooked in the basic definition of migration is whether the movement is voluntary or forced – for example as a result of violence or natural disasters. Finally, it does not consider whether contacts in the region of origin are maintained and to what extent individuals or groups repatriate to their homelands.

Refluxes of various kinds form an important factor in prehistoric migrations, especially the practice of sending foster children to be raised by other kin groups. The Indo-European diaspora shows clear signs of such a system, as reflected in linguistic and archaeological evidence, as well as in myths and traditions. Marriage and child fostering helped establish and maintain long-distance alliances, but also offered an effective means of spreading Indo-European culture and cosmology. When young boys and girls were put into foster care, after a number of years they would usually return to their parental groups, unless they

married into new groups, thus creating new or strengthening existing alliances (Kristiansen 2022: 51-54).

Another important aspect of many migrations is that they are, at least in part, irreversible (Moretto & Vergalli 2008: 225) – a fact that is clearly illustrated by many historical examples of the movement of individuals and groups. This irreversibility is an important factor in the case of the early Indo-European migrations involving pastoralist groups. While individuals can return to their families and ancestral homelands – crossing rivers and other natural obstacles – it is much more difficult to relocate large herds of animals.

Migrations are driven by different 'push' and 'pull' factors – negative conditions in the home region and opportunities in the future homelands (Anthony 1997). The fact that survival of cattle was the main driver behind the initial expansion of groups who carried the Core Indo-European language and culture across the Eurasian steppe aligns with Garrett Hardin's 1968 theory of 'the tragedy of the commons'. Hardin argued that such a tragedy, which ultimately leads to poverty, can arise when pastoralists compete for the limited resources within a shared space (Hardin 1968: 1244):

> The Tragedy of the Commons develops in this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point, the inherent logic of the commons remorselessly generates tragedy. As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, 'What is the utility *to me* of adding one more animal to my herd?'

And herein lies the tragedy: not only will one herder try to maximize his gain, but so will his peers – resulting in overuse, depletion, and, in the end, poverty and tragedy for all. The solution, which was also adopted by early Indo-Europeans: migration to new areas and pastures. By all accounts, this was a driving force behind the original migration of pastoral groups from the Pontic steppe, who first carried the Core Indo-European language into the wider world from around 3000 BC.

A Water-System Approach

Terje Tvedt developed a Water-System Approach, combining ecology, technology and cosmology. This theoretical and analytical framework is designed to overcome both nature reductionism and nature determinism by analysing particular water-society relationships in time and space. From an analytical perspective, a water-system has three different, closely interconnected, but not hierarchical, analytical 'layers' (Fig. 31). This approach is particularly useful in analyses of, for instance, adaptation and migration of prehistoric animal groups (Tvedt 2006-2016, 2016):

The first layer focuses on *water's physical form and behaviour*. This includes hydrology and precipitation patterns, the velocity of rivers, and the seasonal cycles with their transitions from warm summers to cold, snowy and icy winters. This part of nature and the lived landscape is always in flux, with the physical presence or absence of water shifting throughout the year. For example, pastoral groups who dwelt on the fertile steppes along gently flowing rivers during summer faced few ecological challenges. Comparative studies suggest such conditions were what the early Indo-Europeans aspired to. By contrast, six months later, the same landscape was covered in heavy snow and temperatures dropped to -20°C and below. In such conditions, the same groups struggled to keep themselves and their cattle alive. It was the same people and the same herd, but the water-world had changed completely. Survival now depended on natural variables and pastoralists' ability to adapt and cope with the harsh ecological realities. In the real world, water defined everything for pastoralists whose livelihoods depended on the health and survival of their cattle.

The second layer emphasises *human modifications and adaptations to water-worlds*. In historic and even prehistoric times, man found many ways of modifying the course of water flows in the landscape. Bridges across rivers, aqueducts and cisterns for drinking water, and channels for agriculture and irrigation are just some of the structures that prehistoric man built to adapt, modify and use various water-worlds. Many of these modifications not only changed the course of water flowing through the landscape, but also altered the landscapes themselves, for example by channelling of water for agricultural purposes. However, early Indo-European pastoral groups did not have the technological skills to modify and adapt their water-worlds in such ways.

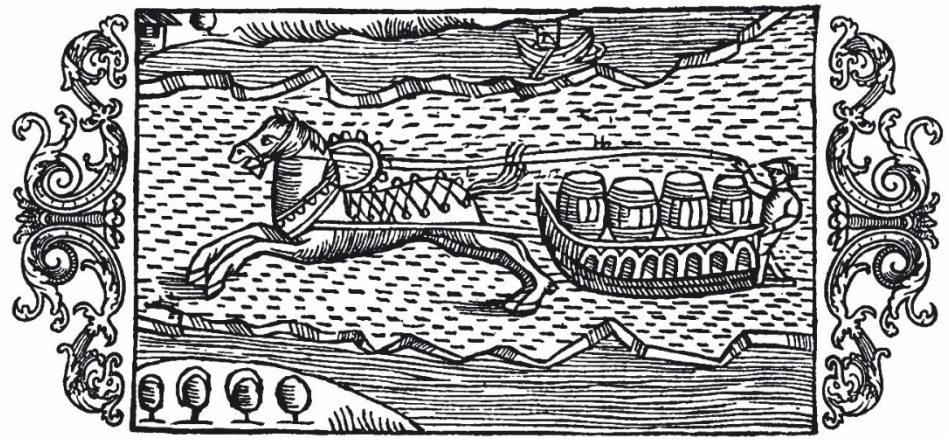

Fig. 31. Transport of heavy goods on ice. The horse pulling a sled is an optimal adaptation of a specific technology (horse and sled) to a specific ecology (ice and frozen water) at a given time (16th century). From Olaus Magnus (1555[1998]) *Description of the Northern Peoples*, Book 1, Ch. 27.

The first migrations included horses – though they were not primarily used for riding at this stage (Librado et al. 2021) – and slow, ox-drawn transport wagons. Two-wheeled chariots and horse riding – which both allowed rapid movement – only emerged with the Sintashta culture, more than a millennium later. From a practical point of view, if the survival of the pastoral group is the main objective, then cattle must be included into this second layer, since herds have specific physical capabilities and limitations. Cows thrive on steppe-grazing lands, but their anatomy is not suited to water. Nevertheless, there are examples of cattle swimming across smaller tributaries of the Nile among the Bari, with people crossing in canoes. Remarkably, these cows could cross rivers spanning nearly 300 m (Luxmoore & Spackman 1953).

This highlights the complex interplay between technology and adaptation. If early Indo-European cattle could swim – though this remains unknown – migration across waterways would still require the pastoralists and their belongings to cross in substantial boats. Small canoes would not suffice, especially considering the heavy ox-drawn wagons used by these groups. Transporting such wagons across rivers in summer would have required proper boats, yet there is no archaeological evidence of such structures among early Indo-European pastoral groups (Fig. 32).

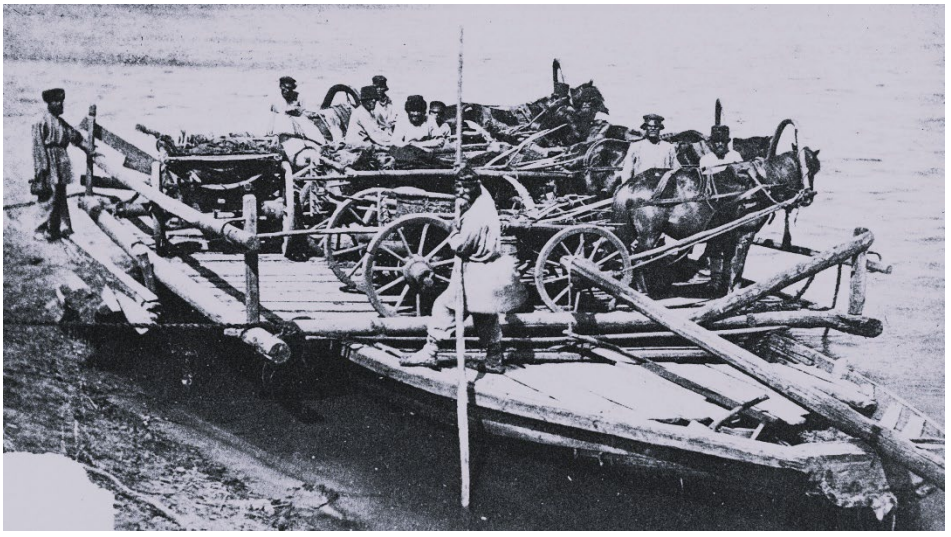

Fig. 32. Boat with horses and wagons. Rivers become obstacles in summer, making the transport of horses and cows difficult. A ferry loaded with people and wagons on a Russian river(?). Library of Congress, https://lccn.loc.gov/99615668. No known restrictions on reproduction.

Such boats probably did not exist in the region during the periods under discussion. Moreover, as pastoralists, these groups had little incentive to develop maritime technologies when the rivers could be easily crossed in winter. If rivers and waterways were major obstacles for much of the year in societies without boats, there was another seasonal challenge that presented even greater difficulties and risks: the so-called 'mud season'. This phenomenon – known in Russian as *Rasputitsa* – meaning 'season of bad roads' or 'when roads cease to exist' – is a defining physical feature of many Ukrainian and Russian river landscapes, especially in spring. It occurs when snow melts rapidly over still-frozen ground, often in combination with rainfall, though similar conditions can arise during heavy autumn rains. Even today, with modern technologies, movement during *Rasputitsa* is extremely difficult. Both during WW1 and WW2 (Fig. 33) it created serious logistical challenges. During this period, it is impossible to move horses, wagons or herds of cattle through these muddy landscapes. For pastoral groups tasked with protecting and managing their livestock, such conditions were dangerous, and mobility – especially with chariots and wagons – would have been severely restricted. In practical terms, these groups would have avoided riverbeds and low-lying areas during the mud season.

Fig. 33. Kursk in 1942. Russia. Source: Wikimedia commons. Pferdegespann im Schlamm. Bundesarchiv Bild 101I-289-1091-26. License: CC BY 3.0.

The third layer addresses *cultural and religious concepts of water*. Human modifications and adaptations to water-worlds are part of culture and cosmology. Certain springs or sections of rivers may be considered as sacred, and specific times and places may call for offerings to rain, a river or weather gods (Tvedt & Oestigaard 2010). In many cultures, changes in weather patterns and the water-world are interpreted from a religious perspective. For pastoral groups, social structures are closely tied to cattle, whose survival depends entirely on pastures and access to water. In short, the cultural and religious concepts of water form a broad framework – not only enabling adaptation and technological innovation, but also all aspects of life, from the cradle to the grave.

A Water-System Approach offers a way to understand the immense variety and ever-changing nature of human-water relations. Hydrology is inherently dynamic and the water-world is in continual flux – changing not only between day and night but also across monthly and seasonal cycles. These fluctuations, including temperature variations, directly affect growth patterns and agriculture (Tvedt & Oestigaard 2016). No two rainfalls are the same, and in the areas of the early Indo-European migrations, warm, dry summers inevitably gave way to cold, snowy winters. The landscape and its water-world are highly dynamic.

Fig. 34. During winter when rivers are frozen, ice may ease the crossing of waterways. 'Crossing the Mississippi on the Ice' by C.C.A. Christensen (1831-1912). Brigham Young University Museum of Art, Utah. Public domain.

What may offer an advantage in one historical context, given a particular technology, could become a disadvantage in another. For example, a frozen river can act both as a barrier and a passageway. If the main transport technologies are canoes or boats, ice halts all movement and becomes a hindrance. But for pastoral groups using horse-drawn carriages, a free-flowing summer river hinders travel, while the same river when frozen in winter could provide an easy route to the other shore (Fig. 34).

Migration and cultures – a model

When discussing prehistoric migration in general and the early Indo-European migration in particular, one is struck by both the speed and vast scale of movement. 'The Yamnaya archaeological complex appeared around 3300 bc across the steppes north of the Black and Caspian Seas, and by 3000 bc it reached its maximal extent, ranging from Hungary in the west to Kazakhstan in the east' (Lazaridis 2025: 1).

Within just 300 years, Indo-European groups had spread across much of Europe and Central Asia – with their cattle. This represents a large-scale and rapid expansion, both westwards and eastwards from the Pontic steppe – the heartland of Yamnaya culture. Migration also took place along a north-south axis. This is evident in the reflux from a branch of the Corded Ware culture in Eastern Europe, which emerged as a blend between Yamnaya and early European farmer populations. This cultural mix gave rise to the Middle Dnieper culture, which in turn developed into the Fatyanovo-Balanovo culture, carrying a variant of the Corded Ware culture northward into the Russian forest-steppe and eastward toward the Urals. In that region, a further southward movement occurred towards the southern Urals, culminating in the emergence of the Sintashta culture, which is created as part of this process (Nordqvist & Heyd 2020; Saag et al 2021; cf. Kaliff & Oestigaard 2023: 109-116).

One way to explain migration and expansion on one hand, and the broader spread and establishment of archaeological cultures over vast areas on the other, is to consider a scenario involving two interconnected patterns of movement. The first is a rapid and large-scale east-west / west-east migration along major waterways; the second is a slower, seasonal north-south migration focused on year-round adaptation and access to pastures. The initial rapid east-west / west-east migration probably occurred along major rivers flowing in an east-west direction (e.g. the Pripyat in the west and the Volga to the east). The seasonal movements followed north-south-flowing rivers, such as the lower reaches of the Volga as it flows to the Caspian Sea. The first rapid, large-scale migration in an east-west direction / west-east was probably a once-in-a-lifetime movement, with pastoral groups moving to and settling in entirely new geographical regions. The seasonal migrations, by contrast, were cyclical adaptations to ecological changes across the year, as pastoral groups moved their cattle from the summer-grazing lands along the rivers in the north to similar environments in the south during the winter.

The combination of extensive east-west migrations and seasonal north-south movement helps explain both the close cultural similarities and differences between cultures. On the one hand, the west-east / east-west migrations created a broad, cohesive Indo-European cultural package encompassing language and cosmology. On the other hand, this overarching similarity was constantly reshaped by 'dialectification': the local adaptation and diversification of cultural traits. Dialecti-

fication occurred over time through interaction with both Indo-European and non-Indo-Europeans groups. As a result, even neighbouring groups that shared a cultural and cosmological framework developed distinct cultural-historical features. These processes were instrumental in the formation of ethnic groups and cultural boundaries between them. Such dynamics help us understand the relationship between cultures such as the Middle Dnieper, Fatyanovo, Balanovo and Abashevo. Although all are regional variants of the broader Corded Ware complex, each archaeological culture displays distinctive features and material culture. The gradual change of the Core Indo-European language and culture – through a combination of dialectification and hybridisation – gave rise to the diverse Indo-European languages and cultures that we encounter later in history.

The early phase of north-south migration – originating from the Volga – may have played a key role in shaping the diversity of distinct traditions and historical patterns that developed within the broader Core Indo-European framework. From this perspective, Fredrik Barth's definition of ethnicity is particularly instructive. Drawing on studies of pastoral groups in the Swat Valley (Pakistan) and Sudan, Barth posited that neighbouring groups could develop strong group identities even while sharing most cultural and cosmological features (Barth 1956, 1969) – such as, in our case, the overall Indo-European package.

During the winter, people often preferred to remain more sedentary if they had sufficient resources. As discussed, this was the pattern that developed over time in many regions, including Scandinavia, where animals were kept indoors during the winter and released in spring for summer grazing. But this pattern does not seem to have applied to early Indo-Europeans, who kept their animals outdoors year-round. Regardless of whether they were stationary or mobile, these groups endured a cold seasonal existence. In this context, mobility was not necessarily more strenuous than the sedentary lifestyle. The primary concern was availability of fodder. Without a large number of people to cut and store hay, it was extremely challenging to collect enough to sustain the herd through the long winter months. The recurring question facing early Indo-European pastoralists every year was: should we stay, or should we go?

Long migrations have always entailed significant risks, whereas short, seasonal migrations in search of fresh pasture cycles represent a risk-minimizing strategy that increases food security. From a risk-mitigation perspective (Beck 1998, 1999), it is best to limit both the

frequency and duration of exposure to risks. Applied to the context of cattle herding, the most effective strategy is to cover the longest distance as quickly as possible to reduce risk. One way to implement such a strategy is to follow watercourses during winter to facilitate rapid migration.

As previously discussed, securing sufficient winter fodder remained a major challenge. If a group remained sedentary through the winter, it had to rely on a large and reliable reserve of fodder. For migrating pastoralists, however, two alternatives can be proposed.

In the first scenario, it is assumed that natural resources along the migration route were scarce. In this case, it is reasonable to assume that pastoralists needed to carry their own fodder supplies during the journey. The faster the migration, the less fodder was required, both for the journey and to sustain the herd through the winter period. Once the group reached its destination, ideally a region with more abundant pastures – cattle could resume grazing at their own pace.

Fig. 35. 'Cattle in the water' by Aelbert Cuyp (1620-1691). Museum of Fine Arts, Budapest. Public domain.

The second scenario assumes the presence of sufficient fodder and water along the migration routes (Fig. 35). Studies by David Anthony (2016) and others have shown that pastoralists favoured riverbanks during the winter, as they offered reeds for cattle to feed on. If these conditions prevailed along the Volga – and possibly also the Pripyat – in prehistoric times, then migration would have increased access to fodder and improved chances of survival. In other words, migration was a risk-mitigation strategy. However, if many groups used the same routes, the resources along the waterways would have come under pressure. A more likely scenario, therefore, combines natural grazing along the shores and use of previously collected grass.

Empirical studies have shown that migration is often, at least partially, an irreversible process. Returning to one's place of origin may be difficult or impossible due to a number of social, political and environmental factors such as war, poverty or natural disasters like earthquakes and floods. In the case of pastoral groups, additional reasons come into play. Following Hardin's 'tragedy of the commons' theory, increasing pressure on shared resources – particularly water and grazing land – within a limited area can lead to resource depletion and eventual poverty for all users. However, as discussed above, the first Indo-European east-west / west-east migrations took place under very different ecological and demographic conditions, namely in a frontier setting with, presumably, very few borders (Lattimore & Lattimore 1957, Lattimore 1962).

The image of the American cowboy partially captures the way of living: a masculine, often violent lifestyle centred on protecting the herds when necessary. Fredrick Jackson Turner pioneered frontier studies from the perspective of the white settlers and colonizers in North America (Turner 1893, 1920). However, contrary to the common perception at the time that the land was open and free, it is now recognised that Native Americans inhabited these spaces.

In the case of the early Indo-European migrations, it is difficult to reconstruct the setting and conditions. Nonetheless, it is reasonable to assume that large parts of the Eurasian steppe were sparsely populated at the time and that high-quality grazing lands were widely available across the vast east-west axis.

A plausible scenario may have unfolded as follows: when the first group of Indo-European pastoralists migrated along the west-east course of the Volga River, they encountered abundant pastures in the eastern and southern regions of the river basin. However, once a

pastoral group established itself in a particular area, opportunities for other groups became more limited – unless they engaged in conflict over increasingly scarce resources. A more pragmatic and less conflictual strategy for later groups would have been to move further east towards the rich pastures south of the Volga. This migration pattern could help explain the Indo-European expansion in both eastern and southern directions. In essence, each wave of migration created a ripple effect, with pastoral groups moving progressively farther afield to find free pastures south (and north) of the river, much like concentric rings spreading across water. East of the Kama, where the Volga turns southwards, the steppe was open and the continued migration eastwards allowed the emergence of new cultures such as the Sintashta.

Such a model helps explain how rapid migrations could occur over vast distances in a relatively short period of time – both westward into Europe and eastward across Eurasia – and how distinct cultures developed within a broader framework of the Indo-European cultural and linguistic package. If we compare the natural geography, the presence of major waterways flowing in a west-east direction, the corresponding scenario can also be applied to the Pripyat River to the west. This original migration was very significant for the Corded Ware expansion westward and its fusion with Europe's early farmers, creating the Indo-European cultural package.

If the frontiers of the Eurasian steppe advanced rapidly, they would eventually have reached a saturation point, where further movement was no longer possible due to the presence of other pastoralist groups on the land. Return migration would not have been an option either, as the territories that had been left behind had been settled by new groups. In this way, after the initial wave of rapid westward and eastward migration, all pastoral groups were locked in a system largely defined by the north-south flowing rivers. The areas to both the south and north of these rivers were rapidly populated, locking the land and limiting further expansion in these directions. Yet this process also allowed for the spread and emergence of what archaeologists call 'cultures' – areas with distinct cultural traits and traditions that can be identified through time and space.

Moreover, in later times of environmental stress – such as a drought – east-west migration would have increased risks rather than mitigating them. Conditions were probably not better on the other side of the river, given the ecological similarities on both sides. Furthermore, crossing rivers during the summer posed logistical challenges, and if pasture was

already scarce, moving into another group's area would only intensify competition over limited resources and increase the death toll among humans and animals. From this perspective, depending on population pressure, pastoral groups would sooner or later become locked into a system resembling Hardin's tragedy of the commons.

In good years, north-south migration would have been the most ecologically viable – and, in practice, the only sustainable – strategy, as it allowed animals to access environments with potentially better grazing and more abundant water resources.

Continuity of migrations

Beyond the initial wave of migration, there were also episodes of demographic reflux and renewed cultural contacts, as evidenced by the chariots from Gallemose in Denmark or Kivik in Sweden, but also the fostering of children. In winter, the rivers continued to serve as communication and transport highways for centuries and even millennia. With the advent of boats in the Bronze Age, rivers remained important, enabling transport and communication even during summertime. By the Viking Age, winter transport along Eurasian rivers had long ceased, but the centrality of the rivers and the knowledge of these ancient waterways lived on, perpetuating contact and trade networks, which, arguably had been established with the early Indo-European Silk Roads.

9. Conclusion – a critical view

Mapping and modelling Indo-European migrations and cultures

After this exposé of population movements, cultural exchanges and contact routes across the Eurasian region over the past six millennia, we will now briefly summarize our conclusions.

We have placed particular emphasis on the concept of the Silk Roads, broadly interpreted as a framework for understanding which routes have historically offered more favourable conditions for long-distance travel. While the term 'Silk Roads' may evoke images of historical trade in luxury goods along 'the classical Silk Road' – Central Asia's caravan routes – it is important to note that the prerequisites for long-distance contact across Eurasia predate the historical Silk Road by many millennia. The importance of these historical trade routes, and the documentation that exists around them, are, however, invaluable for understanding the prerequisites for other types of contacts, routes and migration. Descriptions of the historical Silk Roads – extending from China to Europe – provide a good picture of the prerequisites for a certain type of relatively fast movement and long-distance communication. Everything also suggests that the conditions for the kind of rapid trade and communication routes that the Silk Roads constitute were already in place more than 5000 years ago, which explains the extensive and effective spread of Indo-European languages and cultures.

But this is, of course, not the whole picture. An important aspect of early Indo-European migration is that it was undertaken by large-scale livestock keepers, meaning that grazing opportunities and the movement patterns of animals were decisive in shaping migration routes. These factors are, however, not fully reflected in the extent of the trade routes. Yet rather than contradicting each other, these two dynamics offer a complementary perspective, where different conditions cooperated to enable the rapid, long-distance movement that was crucial for early Indo-Europeanization.

At the outset, we adopted the following methodological approach: 'the basic procedures of…[our] analysis involve first making a series of functional or logical models which can be interwoven, then, second, constructing a single model which can generate the different forms' (Goody 1987: vii-viii). By following in the footsteps of cows – rather than

merely looking at humans on horseback – we provide a different perspective of prehistoric mobility and migrations. This has enabled us to combine four logical and functional models into a single framework capable of generating and explaining specific prehistoric phenomena.

First, while cows may be stubborn animals, their welfare lies at the heart of pastoral life. If the cattle die, people die. Therefore, any proposed migration route that does not prioritize the survival of livestock is inadequate. Equally important is understanding how, when and why cattle can move, as moving large herds is not always possible, nor possible everywhere.

Second, the landscape and water-world of the Eurasian steppes impose specific constraints. It is not only very flat, but also bisected by a network of north-south flowing rivers. These wide rivers, especially during the summer months, become difficult – if not impossible – to cross with huge herds and wagons.

Third, while the earliest Indo-European migrations occurred rapidly in east-west / west-east directions, later ethnographic descriptions of pastoralism in similar environments typically describe seasonal north-south migrations – northward in summer and southward in winter.

Fourth, even in the earliest phases of Indo-European expansion, there were distinguishable and closely related archaeological cultures, such as the Middle Dnieper, Fatyanovo and Abashevo cultures. This indicates that while the broader movement was mainly along a west-east axis, there were also parallel north-south movements, which contributed to the formation of specific cultures and traditions within different regions.

Thus, by tracing the cattle and their needs – water and fodder – we are able to identify a more northern migration route, which followed frozen waterways, particularly the Volga. We argue that this model accommodates and integrates all four analytical parameters discussed above. We believe that this offers a more viable research approach than those focused solely on language, genetics or archaeological finds – or the common narrative of male-dominated horseback migrations. Even when all this empirical evidence is taken into account, it is insufficient. The early Indo-Europeans were, above all, pastoral nomads. They lived in an environment characterised by long, harsh winters, an ecological limitation that must be included in models that attempt to understand migration of pastoral groups with large herds.

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